

## Contours Datalayer

December 2000

### OVERVIEW

The Contours datalayer represents a combination of both 1:25,000 USGS Digital Line Graph (DLG) 3 meter/10 foot contours and 3-meter contours created from Digital Terrain Model (DTM) data points collected during the production of the 1:5,000 Black and White Digital Orthophoto images. Wherever DTM-based data is available, the generated lines supersede the DLG contours. MassGIS obtained the USGS 1:25,000 Hypsography Digital Line Graph from the USGS National Mapping Division. These files were converted into ARC/INFO coverages and projected into the MA State Plane Coordinate System. All contour lines appearing on the USGS quadrangle sheets are included in these coverages. USGS data are **NOT** available for many quads nor are they necessarily available for entire quadrangles if generated contours exist for the same area. The data are stored in the OQ library. Layer name is **CONTOURS**; each coverage is named **HP**.

Arc/INFO TINCONTOUR was used to create the DTM-based contours. Breaklines coded "hard" and "soft" were used in combination with .GEN files containing the "mass" and "spot" DTM points. All of these data were extracted from the original DTM files collected on stereo analytic plotters. The Orthophoto Index Grid coverage was used as a CLIP coverage as the DTM points overlap 5-10 percent in both directions. These 3-meter contours are accurate to +/- 1.5 meters.

### ATTRIBUTES

The .AAT has three items: **MINOR\_NUM**, **ELEV\_M**, and **ELEV\_FT**. **MINOR\_NUM** is the concatenation of the original Minor codes contained in the DLG .ACODE files. The 3-digit codes that comprise **MINOR\_NUM** represent topographic contour classifications such as depressions, underwater depths, and carrying contours (contours with more than one elevation, as happens along cliffs). More information about the 1:25,000 DLG's including detailed descriptions of the Major/Minor code scheme can be found in the USGS National Mapping Division Publication, *Digital Line Graphs from 1:24,000-Scale Maps* (Massachusetts is the only state which has quads produced using the metric system and a 1:25,000 scale). All generated contours are simply coded **MINOR\_NUM** = 200. **ELEV\_M** contains the elevation value in meters. For the few DLG quadrangles which are from 1:24000 scale quads, the contour value originally stored in feet was also converted and rounded to meters. Those elevations originally stored in meters are converted and rounded to feet and also stored in **ELEV\_FT**.

The following table lists **MINOR\_NUM** values and their descriptions as listed by the USGS plus the code for neatlines, 999. Note that these values may be concatenated in the **MINOR\_NUM** item.

200	Ordinary contour
201	Carrying contour
202	Supplementary contour
204	Amended contour
205	Bathymetric contour
206	Assumed bathymetric contour
208	Closure line Approximate
611	Depression
613	Underwater
614	Best estimate
999	Quad neatline

A fourth item, **SRC**, indicates whether a feature is from a USGS DLG file (USGS) or a generated contour (DOQ).

### MAINTENANCE

MassGIS is maintaining this datalayer. As new DTM point data are available, 3 meter contours will be generated and incorporated into this layer. Eventually all USGS DLG lines will be replaced by generated contours. DTM contours are available for areas covered by available 1:5000 orthophotos.

## Contours (1:250,000) Datalayer

February 1990

### OVERVIEW

The 1:250,000 Hypsography datalayer represents elevation contours at a 30-ft. interval. It was created by MassGIS from Defense Mapping Agency data as reformatted by the USGS National Mapping Division. The layer is stored in the BASIN library. The layer name is **CONTOURS250**; each coverage is named **HP250K** (*refer to the Basin Index map at the back of this document*).

### MANUSCRIPT

The source data are the digital elevation models created by the Defense Mapping Agency at a nominal 1:250,000 scale. The original digital elevation files consist of a one degree square array of elevation values at 3 arc-second intervals, (approx. 200 ft.), measured in integer meters. This source data has been classified as level 1 by the USGS, which means that the root mean square error of any sample point is expected to be less than one-half contour interval. In practice, this means that a spot elevation interpolated from contours plotted at an appropriate interval (not less than 20 ft.) would probably be within 30 ft. of its 'true' elevation. Note that in areas where the elevation value is most rapidly changing the vertical error is likely to be larger, but the horizontal distance to a point at the elevation shown will tend to remain the same.

### METHODOLOGY

The original files were too large to process using the Arc/INFO **DEMLATTICE** command, so they were first broken up into smaller files and formatted as Arc/INFO .svf files using FORTRAN routines. Arc/INFO lattice files were then created using the **GRIDLATTICE** command and a low-pass **FILTER** was run on them to 'smooth' the data. The **LATTICEOPERATE** command was used to convert from meters into feet. Contour coverages were created from the lattice files using a contour interval of 30 feet, which was consistent with the input scale of the data. The contour coverages were then **PROJECTED** into state plane feet, and rounded off to feet. The coverages have since been projected into the Massachusetts State Plane Coordinate System, NAD83 meters.

### ATTRIBUTES

This datalayer has an **.AAT** (arc attribute table) with the attribute CONTOUR\_FT.

**NOTE:** It is essential that these data be used at a regional scale consistent with the scale of the source data which is 1:250,000. Not all the contours will line up with such MassGIS data layers as the shoreline, the hydrography or the basin lines. Caution should be exercised in producing graphic output. Some significant features are missing from the original data.

## Digital Orthophoto Points Datalayer

December 2000

### OVERVIEW

The points in this layer were created using Digital Terrain Model (DTM) data points collected during the production of the 1:5000 Black and White Digital Orthophoto images. These points are accurate to National Map Accuracy Standards ( $\pm 1.5$  meters). They are tiled by the Orthophoto Quad Index. Each coverage in the **ELEVATIONS** layer, stored in the OQE library, is named **P**.

### PRODUCTION

The points were produced using the Arc/INFO GENERATE command. The INPUT file was a .GEN file produced with an awk script that contained DTM point coordinates. The items NUMBER and SPOT were added to the .PAT using JOINITEM; their values were obtained from a .DAT file produced with the same awk script. Finally the item SFTYPE was set to 1 for mass. All of these data were extracted from the original DTM files collected on stereo analytic plotters. The points are tiled by the Orthophoto Index Grid coverage, which was used as a CLIP coverage as the DTM points overlap 5-10 percent in both directions. Points are available for areas covered by available 1:5000 orthophotos.

### ATTRIBUTES

Each **.PAT** (point attribute table) contains the following items:

17 SFTYPE	Surface feature type
18 NUMBER	
22 SPOT	Elevation
26 OQ-ID	Source orthophoto tile number

### MAINTENANCE

This datalayer is maintained by MassGIS.

## Digital Orthophoto Breaklines Datalayer

December 2000

### OVERVIEW

The breaklines in this layer were created using Digital Terrain Model (DTM) data points collected during the production of the 1:5000 Black and White Digital Orthophoto images. These breaklines are accurate to National Map Accuracy Standards (+/- 1.5 meters). They are tiled by Orthophoto Index Grid sheets in the OQ library. The layer is named **BREAKLINES**; each coverage is named **L**. For further discussion of the orthophoto and index datalayers please refer to their description pages.

### PRODUCTION

The breaklines were produced using the Arc/INFO GENERATE command. The INPUT file was a .GEN file produced with an awk script that contained DTM point coordinates coded either "hard" or "soft". All of these data were extracted from the original DTM files collected on stereo analytic plotters. The Orthophoto Index Grid coverage was used as a CLIP coverage as the DTM points overlap 5-10 percent in both directions. Breaklines are available for areas covered by available 1:5000 orthophotos.

### ATTRIBUTES

Each coverage has a standard **.AAT** (arc attribute table).

### MAINTENANCE

This datalayer is maintained by MassGIS.

## Land Use Datalayer

May 2001

### OVERVIEW

The MassGIS statewide 1:25,000 land use datalayer has 37 land use classifications interpreted from 1:25,000 aerial photography taken in 1971, 1985, and in some areas, 1990, 1991, 1992, 1995, 1997 and/or 1999. Coverage is complete statewide for the years 1971 and 1985. About half of the state has been updated further to represent land use for various years from 1990 to 1999. This datalayer is stored in the TOWN library; the layer is named **LAND USE** and the individual community coverages are named **LUS**.

The online land use status map at [http://www.state.ma.us/mgis/st\\_lus.htm](http://www.state.ma.us/mgis/st_lus.htm) displays the most up-to-date year of landuse data for each town, including updates for 1999.

The year of most recent photography used for land use data interpretation is stored in a single statewide coverage called **LUSTAT**. This layer was necessitated by the fact that some towns contain partial coverage for a certain year, which eliminated the one-to-one link between town-ID and year.

### PRODUCTION

Photointerpretation and automation were done by the Resource Mapping Project at the University of Massachusetts, Amherst. The RMP staff aggregated the 104 classes of their original 1971 interpretation into 21 categories and digitized the data into individual community digital coverages using a PC version of Arc/INFO software. The RMP staff then visually compared the 1971 photography and 1985 photography and produced a digital map of only 1971-85 change for each community. Interpretation was made from 1:40,000 9"x 9" color infrared photos flown in summer 1985. Southeastern Mass was flown in September 1984. The flight and photography were funded by the Massachusetts Dept. of Environmental Management for another project. Several additional categories of land use were added for parts of Massachusetts. Ten communities in the Southeastern Regional Planning & Economic Development District (SRPEDD) west of Buzzards Bay plus Bourne and Falmouth have a total of 28 land use classes. The 28 classes include the original 21 categories plus 23,24,25,26,27,28 and 29 (see Code Definitions on the next page).

In 1990, the Cape Cod Commission funded an update of Cape Cod. These data are categorized into 26 land use classifications, expanding the original codes to include 23,26,29 and 30. These additional codes, along with the original 21, are listed in LU37\_CODE. Massachusetts Water Resources Authority (MWRA) funded land use interpretation in 1991 for 14 towns. The 33-code scheme for this update includes codes 23,24,29,30,31,32,33,34,35,36 and 37 in addition to the original 21 codes. The Executive Office of Transportation and Construction (EOTC) also funded a 1991 update for 113 towns using the same set of codes as the MWRA except for code 37. The minimum mapping unit used was one acre. These towns that have been updated are listed below.

Each land use coverage was plotted at a scale of 1:25,000 by the RMP before delivery to MassGIS. MassGIS used a workstation version of Arc/INFO to combine data from different years. The process of combining the data from different years created some 'sliver polygons'. These result when a theoretically coterminous line in each coverage is actually offset due to it having been digitized twice, e.g. the shore of a lake. Many of these slivers have been eliminated by screening for an area/perimeter ratio beyond normal limits. Some slivers remain. They have the correct coding, but should actually be merged with an adjacent polygon.

NOTE: This project was funded by the Massachusetts Executive Office of Environmental Affairs (EOEA), the Executive Office of Transportation and Construction, Massachusetts Water Resources Authority and several regional planning agencies. Photointerpretation and digitizing were completed by the UMASS-Amherst Department of Forestry Resource Mapping Project (RMP).

In 1999, EOEa funded the acquisition of statewide 1:25,000 aerial color infrared photography for use in the latest round of land use interpretation. Again, photointerpretation and digitizing were completed by the UMASS Department of Forestry Resource Mapping Project. Statewide data processing by UMASS based on the 1999 photography is expected to be completed by the end of June 2001. Release of the data by MassGIS will follow a quality assurance/quality checking routine.

## ATTRIBUTES

MassGIS created a standard Arc/INFO Polygon Attribute Table (LUS.PAT) with the most recent available land use for each town. Each .PAT contains the following attributes:

<b>TILE-NAME</b>	Town-ID
<b>LU_ID</b>	Unique polygon ID for the town
<b>LU21_CODE</b>	21 category land use code
<b>LU37_CODE</b>	37 category land use code
<b>YEAR</b>	Date of most recent data
<b>RELATE-ID</b>	A redefined item combining the TILE-NAME and RELATE-ID items. This item uniquely identifies each polygon within the state.

Therefore, towns with land use up to 1985 will have their 1985 land use codes in the items LU21\_CODE and LU37\_CODE; towns updated to 1990 through 1997 will have the updated code in these items. It is important to note that even though both the 21- and 37-class items are in each .pat, the LU37\_CODE item may be different only for towns updated beyond 1985. In towns current to 1985, the codes for LU21\_CODE and LU37\_CODE will be the same.

## LAND USE CODE DEFINITIONS

The two land use code items in the table represent two classifications of land use. The 21-category classification aggregates the categories in the 37-category classification as follows:

CODE	ABBREV	CATEGORY	DEFINITION
1	AC	Cropland	Intensive agriculture
2	AP	Pasture	Extensive agriculture
3	F	Forest	Forest
4	FW	Wetland	Nonforested freshwater wetland
5	M	Mining	Sand, gravel & rock
6	O	Open Land	Abandoned agriculture, power lines, areas of no vegetation
7	RP	Participation Recreation	Golf, tennis, playgrounds, skiing
8	RS	Spectator Recreation	Stadiums, racetracks, fairgrounds, drive-ins
9	RW	Water Based Recreation	Beaches, marinas, swimming pools
10	R0	Residential	Multi-family
11	R1	Residential	Smaller than 1/4 acre lots
12	R2	Residential	1/4 - 1/2 acre lots
13	R3	Residential	Larger than 1/2 acre lots
14	SW	Salt Wetland	Salt marsh
15	UC	Commercial	General urban, shopping center
16	UI	Industrial	Light & heavy industry
17	UO	Urban Open	Parks, cemeteries, public & institutional green space, vacant undeveloped land
18	UT	Transportation	Airports, docks, divided highway, freight storage, railroads
19	UW	Waste Disposal	Landfills, sewage lagoons
20	W	Water	Fresh water, coastal embayment
21	WP	Woody Perennial	Orchard, nursery, cranberry bog
22		No Change	Code used by MassGIS during quality checking

The additional categories in LU37\_CODE are:

CODE	ABBREV	CATEGORY
23	CB	Cranberry bog (part of #21)
24	PL	Powerlines (part of #6)
25	RSB	Saltwater sandy beach (part of #9)
26	RG	Golf (part of #7)
27	TSM	Tidal salt marshes (part of #14)
28	ISM	Irregularly flooded salt marshes (part of #14)
29	RM	Marina (part of #9)
30	-	New ocean (areas of accretion)
31	UP	Urban public (schools, churches, and government offices) (part of #17)
32	TF	Transportation facilities (part of #18)
33	H	Heath (part of #6)
34	CM	Cemeteries (part of #17)
35	OR	Orchard (part of #21)
36	N	Nursery (part of #21)
37	-	Forested Wetland (part of #3)

All land use categories were aggregated from 104 categories originally defined in 1971. Further information on them can be obtained from Professor William MacConnell at the Dept. of Forestry, University of Massachusetts, Amherst.

## HISTORICAL LAND USE

To store the older land use codes, a related "Polygon History table" (LUS.PHS) contains the land use for all available years for each polygon. Each .PHS table (stored in the town tile workspace if you are using data in Librarian format) relates to its town's .PAT on the redefined item RELATE-ID (a unique id comprising TILE-NAME and LU\_ID). A statewide version of the LUS.PHS table is also maintained and is stored in the Town library's 'database' workspace. When distributing data as export files, the LUS<town-id>.PHS is included in the .e00 file. Shapefile .exe files contain the town-based .PHS table named lus<town-id>ph.dbf.

<b>TILE-NAME</b>	Town-ID
<b>LU_ID</b>	Unique polygon ID for the town
<b>LU21_CODE</b>	21-category land use code (for YEAR)
<b>LU37_CODE</b>	37-category land use code (for YEAR)
<b>YEAR</b>	Date of historical data (Year of aerial photography used in land use compilation - 1971, 1985, 1990, 1991, 1992, 1995, 1997, 1999)
<b>RELATE-ID</b>	A redefined item combining the TILE-NAME and LU_ID items. This item uniquely identifies each polygon within the state. In shapefile versions of the .PHS files this item is named RELATE_ID and is not redefined.

Here is an example of how to relate from a coverage .PAT to the .PHS table to determine historical land use, using town #105 (Georgetown) as an example. In the LUS.PAT we find this record (polygon 355, indicated by the LU\_ID item):

TILE-NAME	LU_ID	LU37_CODE	LU21_CODE	YEAR	RELATE-ID
105	355	32	18	1991	<b>105 355</b>

The RELATE-ID (highlighted in boxed cells) is this polygon's unique record within the state. Since Georgetown's landuse has been updated to include 1991 data, there are three records for each polygon in the LUS.PHS table - one for each year for which land use has been recorded (1971, 1985, and 1991). Using the RELATE-ID as the common field one can relate to the LUS.PHS table, where we find these three corresponding records:

TILE-NAME	LU_ID	LU37_CODE	LU21_CODE	YEAR	RELATE-ID
105	355	3	3	1971	<b>105 355</b>
105	355	2	2	1985	<b>105 355</b>
105	355	32	18	1991	<b>105 355</b>

Once this relate is established, you may determine the landuse codes for this polygon for 1971 and 1985. In the example above, polygon 355 was coded 3 (forest) in 1971 and 2 (pasture) in 1985. Also found here are the codes for 1991, which match the codes in the .PAT. Because the 37 classification codes are available only for post-1985 landuse data, the more specific code 32 (transportation facility) is used for the LU\_37 item, whereas 18 (transportation) is used for LU21\_CODE in the record where YEAR = 1991. Accordingly, the records for 1971 and 1985 show no difference for LU37\_CODE and LU21\_CODE within each year.

When using the .PHS table in workstation ArcInfo (e.g. ArcPlot), you may need to use the RESELECT command to select a particular YEAR prior to establishing a relate. In ArcInfo 8x, ArcView, or other GIS software packages, users may need to extract the .PHS records for a particular year, and then set a join, link, or relate to the extracted set.

The towns for which 1990/1991 land use is available are:

1 ABINGTON (EOTC)	83 EAST BRIDGEWATER (EOTC)	174 MAYNARD (EOTC)	258 SALEM (EOTC)
2 ACTON (EOTC)	86 EASTHAM (CAPE)	175 MEDFIELD (EOTC)	259 SALISBURY (EOTC)
7 AMESBURY (EOTC)	88 EASTON (EOTC)	176 MEDFORD (MWRA)	261 SANDWICH (CAPE)
9 ANDOVER (EOTC)	92 ESSEX (EOTC)	177 MEDWAY (EOTC)	262 SAUGUS (EOTC)
10 ARLINGTON (MWRA)	93 EVERETT (MWRA)	178 MELROSE (EOTC)	264 SCITUATE (EOTC)
14 ASHLAND (EOTC)	96 FALMOUTH (CAPE)	179 MENDON (EOTC)	266 SHARON (EOTC)
16 ATTLEBORO (EOTC)	99 FOXBOROUGH (EOTC)	180 MERRIMAC (EOTC)	269 SHERBORN (EOTC)
18 AVON (EOTC)	100 FRAMINGHAM (EOTC)	181 METHUEN (EOTC)	270 SHIRLEY (EOTC)
19 AYER (EOTC)	101 FRANKLIN (EOTC)	182 MIDDLEBOROUGH (EOTC)	274 SOMERVILLE (MWRA)
20 BARNSTABLE (CAPE)	105 GEORGETOWN (EOTC)	184 MIDDLETON (EOTC)	277 SOUTHBOROUGH (EOTC)
23 BEDFORD (EOTC)	107 GLOUCESTER (EOTC)	185 MILFORD (EOTC)	284 STONEHAM (MWRA)
25 BELLINGHAM (EOTC)	115 GROTON (EOTC)	187 MILLIS (EOTC)	285 STOUGHTON (EOTC)
26 BELMONT (MWRA)	116 GROVELAND (EOTC)	188 MILLVILLE (EOTC)	286 STOW (EOTC)

28 BERLIN (EOTC)	118 HALIFAX (EOTC)	189 MILTON (EOTC)	288 SUDBURY (EOTC)
30 BEVERLY (EOTC)	119 HAMILTON (EOTC)	196 NAHANT (EOTC)	291 SWAMPSCOTT (EOTC)
31 BILLERICA (EOTC)	122 HANOVER (EOTC)	198 NATICK (EOTC)	293 TAUNTON (EOTC)
32 BLACKSTONE (EOTC)	123 HANSON (EOTC)	199 NEEDHAM (EOTC)	295 TEWKSBURY (EOTC)
34 BOLTON (EOTC)	125 HARVARD (EOTC)	205 NEWBURY (EOTC)	298 TOPSFIELD (EOTC)
35 BOSTON (MWRA)	126 HARWICH (CAPE)	206 NEWBURYPORT (EOTC)	300 TRURO (CAPE)
36 BOURNE (CAPE)	128 HAVERHILL (EOTC)	207 NEWTON (EOTC)	301 TYNGSBOROUGH (EOTC)
37 BOXBOROUGH (EOTC)	131 HINGHAM (EOTC)	208 NORFOLK (EOTC)	303 UPTON (EOTC)
38 BOXFORD (EOTC)	133 HOLBROOK (EOTC)	210 NORTH ANDOVER (EOTC)	304 UXBRIDGE (EOTC)
40 BRAINTREE (EOTC)	136 HOLLISTON (EOTC)	211 NORTH ATTLEBOROUGH (EOTC)	305 WAKEFIELD (MWRA)
41 BREWSTER (CAPE)	138 HOPEDALE (EOTC)	213 NORTH READING (EOTC)	307 WALPOLE (EOTC)
42 BRIDGEWATER (EOTC)	139 HOPKINTON (EOTC)	215 NORTHBOROUGH (EOTC)	308 WALTHAM (MWRA)
44 BROCKTON (EOTC)	141 HUDSON (EOTC)	216 NORTHBRIDGE (EOTC)	314 WATERTOWN (EOTC)
46 BROOKLINE (MWRA)	142 HULL (EOTC)	218 NORTON (EOTC)	315 WAYLAND (EOTC)
48 BURLINGTON (EOTC)	144 IPSWICH (EOTC)	219 NORWELL (EOTC)	317 WELLESLEY (EOTC)
49 CAMBRIDGE (MWRA)	145 KINGSTON (EOTC)	220 NORWOOD (EOTC)	318 WELLFLEET (CAPE)
50 CANTON (EOTC)	146 LAKEVILLE (EOTC)	224 ORLEANS (CAPE)	320 WENHAM (EOTC)
51 CARLISLE (EOTC)	147 LANCASTER (EOTC)	229 PEABODY (EOTC)	322 WEST BRIDGEWATER (EOTC)
52 CARVER (EOTC)	149 LAWRENCE (EOTC)	231 PEMBROKE (EOTC)	324 WEST NEWBURY (EOTC)
55 CHATHAM (CAPE)	155 LEXINGTON (EOTC)	232 PEPPERELL (EOTC)	328 WESTBOROUGH (EOTC)
56 CHELMSFORD (EOTC)	157 LINCOLN (EOTC)	238 PLAINVILLE (EOTC)	330 WESTFORD (EOTC)
57 CHELSEA (MWRA)	158 LITTLETON (EOTC)	239 PLYMOUTH (EOTC)	333 WESTON (EOTC)
64 CLINTON (EOTC)	160 LOWELL (EOTC)	240 PLYMPTON (EOTC)	335 WESTWOOD (EOTC)
65 COHASSET (EOTC)	163 LYNN (EOTC)	242 PROVINCETOWN (CAPE)	336 WEYMOUTH (EOTC)
67 CONCORD (EOTC)	164 LYNNFIELD (EOTC)	243 QUINCY (EOTC)	338 WHITMAN (EOTC)
71 DANVERS (EOTC)	165 MALDEN (EOTC)	244 RANDOLPH (EOTC)	342 WILMINGTON (EOTC)
73 DEDHAM (EOTC)	166 MANCHESTER (EOTC)	245 RAYNHAM (EOTC)	344 WINCHESTER (MWRA)
75 DENNIS (CAPE)	167 MANSFIELD (EOTC)	246 READING (EOTC)	346 WINTHROP (EOTC)
78 DOVER (EOTC)	168 MARBLEHEAD (EOTC)	248 REVERE (EOTC)	347 WOBURN (MWRA)
79 DRACUT (EOTC)	170 MARLBOROUGH (EOTC)	251 ROCKLAND (EOTC)	350 WRENTHAM (EOTC)
81 DUNSTABLE (EOTC)	171 MARSHFIELD (EOTC)	252 ROCKPORT (EOTC)	351 YARMOUTH (CAPE)
82 DUXBURY (EOTC)	172 MASHPEE (CAPE)	254 ROWLEY (EOTC)	

The following towns have been updated by UMass-Amherst using aerial photography flown during the years listed in parentheses:

ADAMS (1997)	CONWAY (1997)	HATFIELD (1997)	NORTHFIELD (1997)	SAVOY (1997)
ASHBURNHAM (1997)	DEERFIELD (1997)	HADLEY (1997)	NORTHAMPTON (1997)	SHELBURNE (1995, 1997)
ASHBY (1997)	ERVING (1997)	HAWLEY (1997)	NORTH ADAMS (1997)	SOUTHWICK (1997)
ASHFIELD (1997)	FLORIDA (1997)	HEATH (1997)	ORANGE (1997)	SUNDERLAND (1997)
ATHOL (1997)	GARDNER (1997)	HUBBARDSTON (1992, 1997)	PETERSHAM (1992)	TEMPLETON (1992, 1997)
BERNARDSTON (1997)	GILL (1997)	LEYDEN (1997)	PHILLIPSTON (1992, 1997)	WARWICK (1997)
BUCKLAND (1995)	GOSHEN (1997)	MONROE (1997)	PLAINFIELD (1997)	WENDELL (1992, 1997)
CHARLEMONT (1997)	GRANBY (1997)	MONTAGUE (1997)	ROWE (1997)	WESTMINSTER (1992, 1997)
COLRAIN (1997)	GREENFIELD (1997)	NEW SALEM (1992)	ROYALSTON (1997)	WINCHENDON (1997)

## MAINTENANCE

MassGIS is maintaining this layer. Currently UMass-Amherst is developing land use data interpreted from 1999 1:25,000 color infrared photography. As MassGIS receives data from UMass they will go through a comprehensive quality-checking procedure and then be made available for general distribution. By late summer 2001 this 1999 land use should be available statewide. For the current availability please see the Land Use Status Map online at [http://www.state.ma.us/mgis/st\\_lus.htm](http://www.state.ma.us/mgis/st_lus.htm).



## Surficial Geology Datalayer

October 1999

### OVERVIEW

MassGIS has produced a statewide surficial geology datalayer showing the location of sand and gravel deposits. Originally the data were divided into three panels- west, east, and southeast that correspond to the USGS 1:250,000 map sheets that were used as a basemap. This datalayer is very generalized when compared to the other MassGIS data. MassGIS only uses the surficial geology data to produce volume or area measurements over a large region, e.g. a drainage basin. It is not accurate for site specific analysis.

As part of a major data development effort, the datalayer has been greatly enhanced. Now panelled by major basin groupings in Librarian, the data includes areas of fine-grained deposits and floodplains. For the original southeast panel, the 1:250,000 Providence, RI sheet, large sand deposits have also been delineated. Additionally, contour lines indicating depth of sand and gravel deposits have also been added. The coverages are called **SG** and are tiled by the WATRSHD2 library.

### MANUSCRIPT

This datalayer was interpreted and compiled by Byron Stone, a USGS geologist. A set of USGS 1:250,000 film basemaps were enlarged onto stable based film at a scale of 1:125,000. The data were then recompiled from a set of 1:25,000 quadrangle sheets onto the 1:125,000 basemap. This manuscript does not precisely register with the standard MassGIS basemap.

### METHODOLOGY

For the original datalayer production, the tics of the Transverse Mercator manuscripts were projected into the MassGIS State Plane coordinates before digitizing began. Polygons were labeled and a checkplot was made at manuscript scale.

The enhancement, also interpreted and compiled by Byron Stone, was completed in the fall of 1992. With the enlarged maps as basemaps, the fine-grained deposits, floodplains and contours were drafted onto film. MassGIS completed all digitizing from these overlays and subsequently, the linework was transformed and projected into state plane coordinates. As with the original manuscripts, these overlays do not precisely register with the MassGIS basemap. Plots were made at a scale of 1:125,000 and compared to the original manuscripts. The coverages were clipped to the 1:100,000 coastline.

In October 1999 this layer was moved from the BASIN library to WATRSHD2 when MassGIS received additional data from Pete Steeves of the USGS office in Northborough, Mass., that completed the entire extent of all watersheds that cover Massachusetts. At the same time the layer was edited to remove old county lines that remained from a previous tiling scheme.

### ATTRIBUTES

Each **SG.PAT** contains the following attributes:

<b>CODE</b>	1 - sand and gravel deposits 2 - till or bedrock 3 - sandy till over sand 4 - end moraines 5 - large sand deposits, where distinguished from sand and gravel deposits 6 - fine-grained deposits 7 - floodplain alluvium
<b>AREA-ACRES</b>	area in acres
<b>RANGE</b>	of depth of deposit, in feet, for code = 1 or 5

### MAINTENANCE

MassGIS is managing this datalayer.

## Soils Datalayer

December 2000

### OVERVIEW

The soils datalayer has been automated from 1:25,000 published soils surveys as provided on various media by the United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS). All soils data released by MassGIS have been "SSURGO-certified," which means they have been reviewed and approved by the NRCS and meet all standards and requirements for inclusion in the national release of county-level digital soils data. Soil survey areas are roughly based on county boundaries and the soils datalayer is stored in the QUAD2 library as 2 coverages per 7.5 minute USGS quadrangle. The **SOILS** layer (coverage **SOI**) contains the soil polygons; the **SOILSPOT** layer (coverage **SPO**) contains the special and ad hoc features.

**This data set is not designed for use as a primary regulatory tool in permitting or siting decisions, but may be used as a reference source.** Organizations, agencies, units of government or others may interpret this information, based on needs; however, they are responsible for the appropriate application. Federal, state, or local regulatory bodies are not to assign to the NRCS any authority for the decisions that they will make. The NRCS will not perform any evaluations of these maps for purposes related solely to state or local regulatory programs.

Maps that use NRCS SSURGO data must show the source (NRCS) and date and, space permitting, contain the following notation:

**"This Soil Survey Geographic (SSURGO) data base was produced by the U.S. Department of Agriculture, Natural Resources Conservation Service and cooperating agencies for the Soil Survey of \_\_\_\_\_ County, (state). The soils were mapped at a scale of \_\_\_\_\_ with a \_\_\_\_\_ acre minimum size delineation. Enlargement of these maps to scales greater than that at which they were originally mapped can cause misunderstanding of the detail of mapping. If enlarged, maps do not show the small areas of contrasting soil that could have been shown at a larger scale. The depicted soil boundaries and interpretations derived from them do not eliminate the need of onsite sampling, testing, and detailed study of specific sites for intensive uses. Thus, this map and its interpretations are intended for planning purposes only. Digital data files are periodically updated. Files are dated, and users are responsible for obtaining the latest version of the data."**

Specifics for each survey area can be found in the 'meta<survey\_area>.txt' files that MassGIS distributes with all SSURGO data. The <survey\_area> is an abbreviated county name, e.g. 'HHEA' for the Hampden-Hampshire East survey area (comprising the eastern portion of Hampden and Hampshire Counties).

### PRODUCTION

Source materials vary by survey area and include scribecoat, clear film positives, and half-tone mylars containing soil lines as well as labels and cultural features. Source sheets to date contained data by "third-quad," a standard NRCS tiling scheme for its published surveys which splits a USGS quadrangle into three sections (north, central and south). Each survey done to date has been based on 1:25,000 orthophoto base maps. Source mylars were scanned at a resolution of 500 dots per inch. The scanned images were registered, rectified, and converted to grids using ARC/INFO. Soils linework was extracted from the grids in the ARC/INFO GRID module and vectorized. MassGIS completed all processing from scanning through vectorization. Map neatline development, line smoothing, labeling, edge matching, and merging of third-quads into full 7.5 minute quads was done by Massachusetts Department of Food and Agriculture staff. Special and ad hoc features such as rock outcrops or stripped land areas that are smaller than the original NRCS minimum mapping units were manually digitized by DFA. These features were captured due to their uniqueness in their surroundings and are represented as point and line data because they are too small to be shown as area features at the scale

of mapping. They form a coverage (SPO) separate from the soil area delineation. Mass DFA staff performed all quality checking prior to submittal for SSURGO certification. The NRCS Missouri Digitizing Unit reviewed the soil coverages and special and ad hoc features for adherence to Soil Survey Geographic (SSURGO) database standards. Once SSURGO certified by the Missouri Unit, MassGIS added annotation classes to the SOILS coverages. ANNO.CODE comprises the CODE item, ANNO.STATELEG the STATELEG item. In Arcplot use TEXTSET FONT to display the annotation.

## ATTRIBUTES

Each **SOLPAT** contains the following items:

<b>CODE</b>	The soil map unit that appears in the published soil survey. A map unit is identified and named according to the taxonomic classification of the dominant soil or soils.
<b>SS_AREA</b>	Code for soil survey area
<b>STATELEG</b>	The corresponding code from the statewide legend. Published soil surveys vary in coding schemes and the statewide legend assigns one symbol to a soil map unit across the state.
<b>SLOPE</b>	Slope of the landscape, derived from the last character of the STATELEG item, if present Possible SLOPE codes are: A: 0-3%    B: 3-8%    C: 8-15%    D: 15-25%    E: 25-35%    0: Water or urban land (no slope)
<b>SS_CODE</b>	A unique value that contains both the CODE and the soil survey area item (SS_AREA) as a redefined item.

Each **SOLAAT** contains the following items:

<b>BOUNDARY</b>	The boundaries of the soil survey area are coded as 'SS_SURV' and arcs representing USGS Quad tile boundaries are coded as 'QUAD.'
<b>TYPE</b>	Source of linework for lines added or edited after scanning during production. Possible TYPE codes are: SOIL: from scan    DIGIT: digitized on screen or with tablet TOWNS: USGS town line used instead of NRCS polygon boundary

Each special/ad hoc feature **SPO** coverage contains a **.PAT** and **.AAT** with the following items:

<b>LABEL</b>	contains a three or four letter code representing the special or ad hoc feature description.
<b>MAJOR</b>	contains a numeric code representing a feature category based on USGS major code categories.
<b>MINOR</b>	contains USGS/NRCS codes that define nodes, areas, lines, and points.

Annotation was created for all soils polygons based on the 'LABEL' item in the .PAT.

## RELATED DATABASE FILES

Map Unit Delineations are described by the Map Unit Interpretations Record data base. This attribute data base gives the proportionate extent of the component soils and the properties for each soil. The data base contains both estimated and measured data on the physical and chemical soil properties and soil interpretations for engineering, water management, recreation, agronomic, woodland, range, and wildlife uses of the soil. This database consists of the following relational tables developed by the NRCS:

**SOLCOMP** (map unit component) - stores information on soil map unit components  
**SOLCOMPYLD** (component crop yield) - stores crop yield information for soil map unit components  
**SOLFOREST #** (forest understory) - stores information for plant cover as forest understory for soil map unit components  
**SOLHELCLASS** (highly erodible lands class) - stores the highly erodible land classification for wind and water assigned to the soil map units  
**SOLHYDCOMP** (hydric component information) - stores data related to the hydric classification, criteria, landform, etc.  
**SOLINCLUSN** (map unit inclusion) - stores the names of soils included in the soil map units  
**SOLINTERP** (interpretation) - stores soil interpretation ratings (both limitation ratings and suitability ratings) for soil map unit components  
**SOLLAYER** (soil layer) - stores characteristics of soil layers for soil map unit components  
**SOLMAPUNIT** (map unit) - stores information that applies to all components of a soil map unit  
**SOLMUOACRE** (map unit county acres) - stores the number of acres for the map unit within a county  
**SOLMUYLD** (map unit yield) - stores crop yield information for the soil map unit  
**SOLPLANTCOM #** (plant composition) - stores plant symbols and percent of plant composition associated with components of a soil map unit

**SOI.PLANTNM** \* (plant name) - stores the common and scientific names for plants used in the database. Relates to SOI.PLANTCOM on the 'PLANTSYM' item.

**SOI.RANGENM** \* (range name) - stores the range site names (table not populated). Relates to SOI.RSPROD on 'RSID'.

**SOI.RSPROD** # (range site production) - stores range site production information for soil map unit components

**SOI.SSACOAC** \* (soil survey area county acreage) - stores the acreage for the county within the boundary of the soil survey area. Relates to SOI.MAPUNIT by the 'STSSAID' item and to SOI.MUCOACRE on the 'CNTYCODE' item.

**SOI.SSAREA** \* (soil survey area) - stores information that will apply to an entire soil survey area. Relates to SOI.MAPUNIT and SOI.SSACOAC on the 'STSSAID' item.

**SOI.TAXCLASS** \* (taxonomic classification) - stores the taxonomic classification for soils in the data base. Relates to SOI.COMP on the 'CLASCODE' item.

**SOI.WINDBRK** # (windbreak) - stores information on recommended windbreak plants for soil map unit components

**SOI.WLHABIT** (wildlife habitat) - stores wildlife habitat information for soil map unit components

**SOI.WOODLAND** (woodland) - store information on common indicator trees for soil map unit components

**SOI.WOODMGT** (woodland management) - stores woodland management information for soil map unit components

**SOI.YLDUNITS** \* (yield units) - stores crop names and the units used to measure yield. Relates to SOI.MUYLD on the 'CROPNAME' item.

These INFO tables relate to the coverage .PATs on the item 'STATELEG,' which uniquely identifies a soil map unit across the state. The INFO file **SOI.PRL** contains the relates for the 17 INFO files above containing the 'STATELEG' item. Table names with the '\*' symbol above do not have direct links to the .PATs; these tables are related to other tables on other items as indicated in the specific descriptions above. MassGIS added the STATELEG item to each of these tables with the pre-existing item MUID (Mapunit Identification Symbol), which is a concatenation of the soil survey area id and the state legend code. The STATELEG item makes it possible to link to these relational tables regardless of survey area. The tables indicated with a '#' symbol above are part of the standard NRCS SSURGO release but deal with crops that don't occur in New England and thus are not populated.

One additional non-relational table provides further information:

**SOI.CODES** (data base codes) - stores information on all codes used in the data base

The following table provides descriptions of the codes used in the SPO coverages:

**SOI.FEATURES** (special feature codes) - stores information on all codes used in the 'LABEL' item in each special feature 'SPO' coverage.

SPO 'LABEL' codes include:

- CLA - Clay spot
- DRY - Dry spot
- ESB - Escarpment, bedrock
- ESO - Escarpment, other
- GPI - Gravel pit
- GRA - Gravelly spot
- LDF - Landfill
- LVS - Levee
- LVXR - Levee without road
- MAR - Marsh or swamp
- MPI - Mine or quarry
- ROC - Rock outcrop
- SAN - Sandy spot
- SLP - Short, steep slope
- SPO - Spoil area
- STN - Stony spot

STR - Stripped land  
 STV - Very stony spot  
 WET - Wet spot

#### Items in the **SOILFEATURES** table:

<b>FEAT_LABEL</b>	Three-character code for special feature
<b>FEAT_NAME</b>	Name of special feature
<b>FEAT_DESC</b>	Full description of special feature

For lists and descriptions of the codes in all of the other tables, please refer to the section “Data base schema” and to Appendix A in the Soil Survey Geographic (SSURGO) Data Base users guide, available as a .pdf (portable document format) file (requiring Adobe Acrobat Reader) from MassGIS or on the world wide web at [http://www.ftw.nrcs.usda.gov/ssur\\_data.html](http://www.ftw.nrcs.usda.gov/ssur_data.html).

## EDITING

Checkplots were made by DFA and reviewed by NRCS staff at various times during the editing process. NRCS soil scientists edgematched each survey area to all abutting surveys (including those in adjacent states) and these edits were incorporated into the quad coverages. Mylar checkplots were provided to NRCS for compilation of special and ad hoc features that were digitized by DFA staff. Each quad within the survey area was submitted to the NRCS Missouri Digitizing Unit for SSURGO review and these edits were incorporated in the final datalayer.

## MAINTENANCE

This datalayer is maintained by DFA. Additional survey areas will be added as they become available. A current status map is at the MassGIS world wide web site at <http://www.state.ma.us/mgis>.

## ADDITIONAL REFERENCES

Further information is available in the form of documents produced and maintained by the NRCS. These documents include:

The National Soil Survey Handbook, a multi-chapter guide that provides the main operational and procedural guidance for the soil survey program. All Handbook chapters are available for download in Microsoft Word 6.0 format on the web at <http://www.statlab.iastate.edu/soils/nssh/>. MassGIS will distribute a digital copy of this handbook (in Microsoft Word format) with the soils data.

The Soil Survey Manual, a single volume book which provides the major principles and practices needed for making and using soil surveys and for assembling and using data related to them. The Manual is intended primarily for use by soil scientists engaged in the classification and mapping of soils and in the interpretation of soil surveys. Although the Manual is oriented to the needs of those actively engaged in preparing soil surveys for publication, workers and students who have limited soils experience or are less familiar with the soil survey process also will be able to use the information. Visit [http://www.nhq.nrcs.usda.gov/JDV/ssmnew/gen\\_cont.html](http://www.nhq.nrcs.usda.gov/JDV/ssmnew/gen_cont.html) to view the Manual on the web.

The Soil Survey Geographic (SSURGO) Data Base, often referred to as the “SSURGO Data Users Guide” or “data dictionary,” provides data use information for users of SSURGO data. The Data Base contains detailed descriptions of the relational tables, including the definitions of soil data elements, definitions of the soil data codes, and a value table. Included are SSURGO attribute relational data base schema. The Data Base also discusses SSURGO map development, data collection, data structure, data voids, map hard copy production, user support, and distribution. This document is available for download as a .pdf (portable document format, viewable in Adobe Acrobat Reader) file on the web at [http://www.ftw.nrcs.usda.gov/ssur\\_data.html](http://www.ftw.nrcs.usda.gov/ssur_data.html). This file also is distributed with all SSURGO data from MassGIS.

## MRIP Contiguous Natural Lands Datalayer

### July 1999

#### OVERVIEW

The MRIP Contiguous Natural Lands datalayer was developed for the purpose of identifying large, contiguous tracts of natural land. "Contiguous" lands were defined using selected roads and a "natural land" definition tailored to meet the objectives of the MRIP (Massachusetts Resource Identification Project). The layer, **NATLANDS**, is stored in the **WATRSHD2** library, with each coverage named **NATL**. Also see the Riparian Corridors and Natural Riparian Corridors layers.

The identification of contiguous natural lands is listed as a priority for numerous conservation planning efforts. The Contiguous Natural Lands datalayer represents a coarse filter analysis of these features. Additional assessment may include: the geometry of these features (area-to-perimeter ratio, core area assessment, etc.), spatial juxtaposition, amount as well as location of "non-natural" landcover classes within and adjacent to natural lands, and spatial distribution of roads greater than class 5 (unimproved roads, trails) within the contiguous natural lands. Also note that the contiguous natural lands were delineated only within the Massachusetts state boundary and therefore may under-represent contiguous natural lands that cross state boundaries.

#### PRODUCTION

Road features from the Massachusetts Highway Department Roads datalayer with a CLASS less than or equal to 5 were combined with the Trains and Transmission lines datalayers, as well as with the state outline, to create boundaries for contiguous natural land polygons. Using ARC/INFO, "natural lands" features were selected from the MRLC National Landcover Datalayer with a reselect on the following landcover categories:

<u>Landcover Code</u>	<u>Description</u>
11	Open Water
31	Bare Rock/Sand
33	Transitional Bare
41	Deciduous Forest
42	Evergreen Forest
43	Mixed Forest
51	Deciduous Shrubland
81	Hay/Pasture
91	Forested Wetland
92	Emergent Herbaceous Wetland

The selected "natural lands" categories were coded as 1 within a NAT attribute item. The contiguous boundaries (roads, trains, transmission lines, state boundary) were unioned with the natural landcover features and then a reselect was applied to produce a datalayer containing contiguous natural lands greater than 250 acres. Because the MRLC National Landcover Datalayer originated as a grid with 30-meter cells, the polygon boundaries appear jagged at large scales. The coverage is best displayed at statewide or regional scales and should not be used for site analysis.

#### ATTRIBUTES

<b>NAT</b>	Contains values of 1 for all "natural lands"
<b>CONTIGACRE</b>	Area in acres for contiguous natural lands polygons, after being clipped for the WATRSHED library
<b>ORIGACRES</b>	Area in acres for the original contiguous natural land polygon greater than 250 acres, prior to being clipped

Selecting NAT = 1 will result in proper display and analysis of the data. Note that this datalayer was originally developed as a single statewide coverage. After being clipped into watershed-based tiles, some of the polygons originally delineated as contiguous natural lands (based on the process described above) were split into two or more polygons. The CONTIGACRE item represents the acreage of the polygon after being clipped. The ORIGACRES item is the acreage of the original, larger polygon that the newly clipped polygon "belonged to" prior to clipping.

#### MAINTENANCE

MassGIS is maintaining this datalayer.

## MRIP Riparian Corridors Datalayer

July 1999

### OVERVIEW

Riparian Corridors are defined as 100 meter corridors encompassing perennial stream and river features as coded within the MassGIS 1:25,000 hydro datalayer. This layer, **RIP-COR**, is stored in the **WATRSHD2** library with each tile's coverage named **RIPC**.

The identification of Riparian corridors has been highlighted as a priority in numerous conservation planning efforts, including the Massachusetts Resource Identification Project (MRIP). The MRIP riparian corridor datalayer represents one iteration, as well as a coarse filter analysis of these features. The 100 meter buffer distance is a subjective value derived from existing conservation plans, as well as current literature. Field verification is recommended as a "next step" in the planning process.

Overlaying the MassGIS hydro wetlands data is recommended for proper interpretation of this data. For example, a riparian corridor may appear to be severed within a landscape when in fact it is simply an area for which the corridor has ingress to a wetland and egress at another point along the wetland feature; wetlands were not included in the definition of riparian corridor. For proper display and analysis of the data select the item **INSIDE = 100**.

### PRODUCTION

Riparian corridors enclose two types of spatial data features (arcs & polygons) and include portions of three general hydro datalayer codes: perennial streams, ponds, and rivers. A stream (a line feature) may flow across the landscape increasing in width to include ponds and rivers (polygon features) along its route. A challenge in creating this datalayer was to include the polygons coded as ponds and rivers and yet omit isolated ponds that are not included in the definition of riparian corridors.

The selection process included:

- Lines with minor\_num codes 412, 412007, 412009, 412020, 412609
- Polygons with minor\_num codes 115, 116, 400, 401, 412, 416, 115007, 115020, 115116, 115410, 115412, 115421, 115422, 115616, 412111, 412115, 619412, 421, 421007, 421619, 421625, 421628, 619421, 421625619, 421619625, 619625421, 101, 122, 101619, 101625, 421101, 619101, 101619625.

Polygon features (ponds) not part of the stream network were deleted through an assessment of tnode = fnode. Bays, estuaries, and mud flats were initially selected for program processing (assuring riparian buffer from rivers edge as opposed to mud flat) and then deleted. The stream network (perennial streams, rivers and selected ponds) was buffered 100 meters on each side of the line features and 100 meters from the edge of polygon features.

### ATTRIBUTES

The .PAT (polygon Attribute Table) contains this item:

**INSIDE** Code value for riparian corridor (inside = 100 represent areas within the corridor)

### MAINTENANCE

MassGIS is maintaining this datalayer. Related layers include MRIP Natural Riparian Corridors and MRIP Contiguous Natural Lands.

## MRIP Natural Land Riparian Corridors Datalayer

July 1999

### OVERVIEW

Natural Land Riparian Corridors are defined as “natural lands” within a 100 meter corridor encompassing perennial stream and river features (as coded in the MassGIS 1:25k Hydrography layer). This datalayer depicts areas within the riparian corridor that remain in a “natural state”, potentially functioning as a corridor for select species movement, as well as additional ecological purposes. It is important to note the “natural land” definition and the distance defining the riparian corridor were tailored to meet the objectives of the Massachusetts Resource Identification Project (MRIP). The layer is named **NAT-COR** and is tiled in the **WATRSHD2** library, with coverages named **NATC**.

The identification of riparian corridors has been highlighted as a priority in numerous conservation planning efforts. Understanding whether the riparian corridor is functional is a logical next step. One approach for assessing the functionality of a riparian corridor is to assess whether it is in a natural condition. The MRIP Natural Lands Riparian Corridor datalayer represents one iteration, as well as a coarse filter analysis of these features. The 100 meter buffer distance is a subjective value derived from existing conservation plans, as well as current literature. The “natural lands” definition is tailored to meet specific project objectives. Field verification is recommended as a “next step” in the planning process.

Overlaying the MassGIS hydro wetlands data is recommended for proper interpretation of these data. For example, a natural land riparian corridor may appear to be severed within a landscape when in fact it is simply an area for which the corridor has ingress to a wetland and egress at another point along the wetland feature. Wetlands were not included in the definition of riparian corridor. In addition, an area within the 100 meter buffer distance may not display as a “natural land” landuse class when in fact it is recognized as a wetland within the Hydro data set. Attribute item **INSIDE** = 100 and **NAT** = 1 should be defined for proper display and analysis of the data.

### PRODUCTION

Riparian corridors consist of two types of spatial data features (arcs & polygons) and include portions of three general hydro datalayer codes: perennial streams, ponds, and rivers. A stream (a line feature) may flow across the landscape increasing in width to include ponds and rivers (polygon features) along its route. A challenge in creating this datalayer was to include the polygons coded as ponds and rivers and yet omit isolated ponds that are not included in the definition of riparian corridors.

The selection process included:

- 25k Hydrography arcs with minor\_num codes 412, 412007, 412009, 412020, 412609
- 25k Hydrography polygons with minor\_num codes 115, 116, 400, 401, 412, 416, 115007, 115020, 115116, 115410, 115412, 115421, 115422, 115616, 412111, 412115, 619412, 421, 421007, 421619, 421625, 421628, 619421, 421625619, 421619625, 619625421, 101, 122, 101619, 101625, 421101, 619101, 101619625

Polygon features (ponds) not part of the stream network were deleted through an assessment of tnode = fnode. Bays, estuaries, and mud flats were initially selected for program processing (assuring riparian buffer from a river's edge as opposed to a mud flat) and then deleted. The stream network (perennial streams, rivers and selected ponds) was buffered 100 meters from the line features and 100 meters from the polygon features. The result is a 100 meter buffer from the line features (perennial streams) and a 100 meter buffer from the edge (arcs) of the polygon features (rivers & selected ponds).

“Natural Land” categories of the MassGIS landuse datalayer (1985/1991, MacConnell) were defined as follows:



<u>Landuse Code</u>	<u>Description</u>
2	Pasture (extensive agriculture)
3	Forest
4	Non-forested freshwater wetland
6	Abandoned agriculture, power lines, areas of no vegetation
14	Saltwater Wetland
20	Water
21	Woody perennial

These selected natural lands were intersected with the Riparian Corridor datalayer to produce the Natural Land Riparian Corridor datalayer.

#### ATTRIBUTES

<b>NAT</b>	Coded "1" for natural lands
<b>INSIDE</b>	Coded "100" for areas within the riparian corridor

#### MAINTENANCE

MassGIS is maintaining the datalayer. Related datalayers include MRIP Riparian Corridors and MRIP Contiguous Natural Lands.

## U.S. EPA Ecoregions Datalayer

July 1999

### OVERVIEW

The U.S. Environmental Protection Agency has construed, from geology, hydrology, climate, and the distribution of species, a set of 13 “ecoregions” in Massachusetts. Ecoregions denote areas within which ecosystems (the type, quality, and quantity of environmental resources) are generally similar; they are designed to serve as a spatial framework for environmental resource management. The layer was obtained for use in the Massachusetts Resource Identification Project and is stored as a single statewide coverage, named ECO-REG. MassGIS modified the original EPA-produced layer by replacing its generalized coastline with the MassGIS 1:100,000 coast. The 13 regions (with ID numbers and names) are as follows:

#### **Northeastern Highlands**

*581 - Taconic Mountains:* An area of high hills and low mountains that contain the highest point in the state, Mt. Greylock. Streams are high gradient and lakes and ponds are rare. Vegetation is generally northern hardwoods with some spruce-fir at higher elevations.

*582 - Western New England Marble Valleys/Berkshire Valley/Houstonic and Hoosic Valleys:* This area is drained by the Hoosic and Housatonic Rivers. This area harbors farms, evergreen forests, transition and northern hardwood forests, and calcareous fens. The limestone in the area creates alkaline lakes and streams.

*583 - Berkshire Highlands/Southern Green Mountains:* The Deerfield, upper Westfield, Hoosic, and Housatonic Rivers drain this area. Lakes and ponds are relatively abundant. This area has deep soils that support northern hardwoods and spruce-fir forests.

*584 - Lower Berkshire Hills:* Similar to the Berkshire Highlands with its common northern hardwoods, but lacks spruce-fir and harbors transition hardwoods. Lakes and ponds are relatively abundant.

*585 - Berkshire Transition:* Forests are transition hardwoods and northern hardwoods. This area drains to the Westfield and Connecticut River basins.

*586 - Vermont Piedmont:* Forests are transition hardwoods and northern hardwoods. Hills are sometimes quite steep. Surface waters are highly alkaline. This area drains to the Deerfield and Connecticut River basins.

*587 - Worcester Plateau:* This area includes the most hilly areas of the central upland with a few high monadnocks and mountains. Forests are transition hardwoods and some northern hardwoods. Forested wetlands are common. Surface waters are acidic. Many major rivers drain this area.

#### **Northeastern Coastal Zone**

*591 - Connecticut River Valley:* The borders of this region are easily defined by the bedrock geology. It has rich soils, a mild climate and low rolling topography. The valley floor is primarily cropland and built land. Central hardwoods and transition hardwood forests cover the ridges.

*592 - Lower Worcester Plateau:* Comprises of open hills and transition hardwood and central hardwood forests. Most parts drain to the Chicopee and Quinebaug Rivers.

*593 - Southern New England Coastal Plains and Hills:* Comprises plains with a few low hills. Forests are mainly central hardwoods with some transition hardwoods and some elm-ash-red maple and red and white pine. Many major rivers drain this area.

*594 - Boston Basin:* Low hills and outlying hilly suburban towns mark this area's rim. The basin itself has low rolling topography and numerous urban reservoirs, lakes, and ponds. The flat areas were once tilled, but are now almost exclusively urban and suburban developments.

*595 - Bristol Lowland/Narragansett Lowland:* This region has flat gently rolling plains. Forests are mostly central hardwoods and some elm-ash-red maple and red and white pine. There are numerous wetlands, some cropland/pasture, and many cranberry bogs. Many rivers drain this area.

*596 - Cape Cod and Islands:* This region was formed by three advances and retreats of the Wisconsin Ice Sheet. The resulting terminal moraines, outwash plains, and coastal deposits characterize the area with their sandy beaches, grassy dunes, bays, marshes, and scrubby oak-pine forests. There are numerous kettle hole ponds, swamps, and bogs. Much of the surface water is highly acidic.

## ATTRIBUTES

The **ECO-REG.PAT** (polygon attribute table) contains the following items:

ECOID	4	5	I	Ecoregion ID number (as listed above)
ECONAME	80	80	C	Ecoregion descriptive name (item added by MassGIS)
FUZZY	3	4	I	Transition areas for which the ecoregion characteristics match both adjacent ecoregions.

The **ECO-REG.AAT** (arc attribute table) contains the following item:

LINE	3	4	I	Line type:
				0 - State Outline    111 - Specific Ecoregion    222 - Coarse Ecoregion    999 - Transitional "fuzzy" area

## MAINTENANCE

MassGIS is maintaining the datalayer. Information on the original EPA layer may be found on the web at <http://www.epa.gov/enviro/html/nsdi/projects/useco.html>.

## Hydrography (1:25,000) Datalayer

### August 2000

#### OVERVIEW

MassGIS has edited and modified both the USGS 1:25,000 Hydrography Digital Line Graph (DLG) quadrangle files and the USGS 1:100,000 Hydrography DLG files and digitized hydrographic features from the USGS 1:25,000 Topographic Quadrangles to produce a hybrid 1:25,000 Massachusetts Hydrography Datalayer. The 1:100,000 DLG features were enhanced by digitizing those streams and ponds from the USGS quadrangles that were not part of the 1:100,000 data. More recently, MassGIS has also scanned USGS mylar separates to replace the 1:100,000 enhanced data with 1:25,000 features.

The 1:25,000 hydrography layer is stored in the QUAD library; each coverage is named **HD**. The paneling scheme may be found at the end of this document (*refer to Quadrangle Index map*), however, the list of quadrangles and data sources are listed below.

#### PRODUCTION

The DLG quadrangles were converted into Arc/INFO coverages and projected into Massachusetts State Plane Coordinate System. The long list of items (MAJOR1, MINOR1, MAJOR2, MINOR2...) were then concatenated to a more simplified coding system. For each feature MINORn was truncated to three characters and linked to the other minor codes to create MINOR\_TOT. For example, a submerged (612) wetland (111) is now coded MINOR\_TOT = 612111. The original MAJORn, MINORn pairs are no longer part of the attribute tables.

The enhanced hydrography is a combination of two sources of data. The 1:100,000 DLGs were split into 1:25,000 quadrangles. The coverages were then enhanced by adding those streams and ponds that are on the 1:25,000 quadrangles, but missing from the 1:100,000 DLGs. Features, such as streams, that appear as polygons with two shores on the quadrangles, but appear as single lines on the 1:100,000 DLGs, were not changed. Linework that is more generalized on the 1:100,000 DLGs than on the quadrangles was not edited either. Only those features that were **missing** from the original 1:100,000 DLGs were added.

Quadrangles covering Nantucket and Martha's Vineyard were completely digitized from the 1:25,000 USGS quadrangles. Though not as thoroughly coded as the 1:25,000 DLGs, the linework is all at 1:25,000.

The scanned quadrangles were automated in-house by scanning USGS mylar separates at 500 dots per inch. The resulting images were vectorized in GRID and then edited in ARCEDIT. Features missing from the blue line separate (i.e. dams or man-made shore) were digitized from the paper quadrangles. Nearly all enhanced hydrography has now been replaced by the scanned and vectorized hydro.

#### EDITING

All of the enhanced, digitized and scanned quadrangles were checkplotted at 1:25,000. The 1:25,000 DLGs were randomly checkplotted. Each of the quadrangles was edgematched to its neighboring quads. The scanned hydrography was compared both to the source mylars and to the paper quadrangles to ensure completeness.

#### ATTRIBUTES

Each **HD<quad-id>** has both a .PAT and .AAT. The modified DLG coding scheme is extensive and includes a wide variety of features, including ponds, cranberry bogs, impoundments, wetlands, tidal flats, dams, streams, and aqueducts. Only the DLGs have been coded this completely. The other hydrography quadrangles have been coded to include ponds and streams and in the case of the scanned quads, wetlands.

Pond and Lake Identification System (PALIS) ids are unique codes which were added to ponds and

lakes by Department of Environmental Protection (DEP) GIS in conjunction with the DEP Division of Watershed Management (DWM) using identification codes developed by the DWM Pond and Lakes Information System. For historical reasons, some wetland polygons have PALIS ids. PALIS ids were also given to impoundment areas along rivers and when necessary closure lines were added.

The items in the .PAT are:

<b>MINOR_TOT</b>	15	15	C	concatenated feature code
<b>SOURCE</b>	3	3	C	data source
				ENH - 1:100,000 enhanced
				DLG - 1:25,000 USGS DLG
				DIG - 1:25,000 digitized quads
				SCN - 1:25,000 USGS mylar separate
				CNR - 1:24,000 Connecticut hydrography
				DEP - DEP modified feature
				MDC - MDC modified feature
<b>PWSID</b>	11	11	C	DEP public water supply identification number
<b>CLASS</b>	3	3	C	feature is within the watershed of a surface water supply
<b>POLY_CODE</b>	4	5	B	generalized code based on MINOR_TOT simplified to 9 codes:
				0 = Land/Island
				1 = Reservoir
				2 = Wetland, Marsh, Swamp, Bog
				3 = Flats, Shoals
				4 = Dam, Weir
				5 = River, Stream, Canal, Spillway
				6 = Lake, Pond, Bay, Ocean, Impoundment
				7 = Other Land Feature
				8 = Other Water Feature
<b>PALIS_ID</b>	6	8	I	a unique ID from the Ponds and Lakes Information System
<b>** Redefined **</b>				
<b>MINOR_NUM</b>	15	15	I	same as MINOR_TOT, integer

The items in the .AAT are:

<b>MINOR_TOT</b>	12	12	C	concatenated feature code
<b>SOURCE</b>	3	3	C	data source
				ENH - 1:100,000 enhanced
				DLG - 1:25,000 USGS DLG
				DIG - 1:25,000 digitized quads
				SCN - 1:25,000 USGS mylar separate
				CNR - 1:24,000 Connecticut hydrography
				DEP - DEP modified feature
				MDC - MDC modified feature
<b>PWSID</b>	11	11	C	DEP public water supply identification number
<b>CLASS</b>	3	3	C	feature is within the watershed of a surface water supply
<b>ARC_CODE</b>	4	5	B	generalized code based on MINOR_TOT simplified to 11 codes:
				0 = Unknown
				1 = Shoreline
				2 = Closure Line
				3 = Apparent Wetland Limit
				4 = Stream
				5 = Intermittent Stream
				6 = River Bank
				7 = Other Water Feature
				8 = Other Land Feature
				9 = Intermittent/Indefinite Shoreline
				98 = Assumed Transport Connection
				99 = Transport Arc
				999 = Quad Tile Neatline
<b>**Redefined **</b>				
<b>MINOR_NUM</b>	12	12	I	same as MINOR_TOT, integer

Symbolizing on the POLY\_CODE and ARC\_CODE items may facilitate display.

## MAINTENANCE

Continued development of this datalayer is underway. Though complete statewide coverage at 1:25,000 or 1:100,000 enhanced is now available, MassGIS is continuing to improve the quality of these data. Those areas that are now covered by enhanced hydrography are being replaced by vectorized 1:25,000 scanned USGS blue color separates.

The following table lists all the possible codes for a **POLYGON FEATURE** in the .PAT. These codes have been extracted and concatenated from the USGS DLG major/minor pairs. The digitized and enhanced hydrography quadrangles do not have the same level of coding.

MINOR_NUM DESCRIPTION	MINOR_NUM DESCRIPTION	MINOR_NUM DESCRIPTION
101 RESERVOIR	105007 INUNDATION AREA	421612 POND-SUNKEN
102 COVERED RESERVOIR	105111 INUN AREA/MARSH	421618 POND-EARTHEN
105 INUNDATION AREA	109421 SEWAGE POND/POND	421619 LAKE OR POND
106 FISH HATCHERY/FARM	109611 SEWAGE POND-ABAND	421625 LAKE OR POND
107 INDUST WATER IMPOUND	109619 SEWAGE POND	421628 LAKE OR POND
109 SEWAGE DISP POND	111007 MARSH/WETLAND	422115 CORAL REEF/FLATS
111 MARSH/WETLAND	111105 MARSH/INUN AREA	610402 INTERMIT PIT W/WATER
114 CRANBERRY BOG	111114 MARSH/CRANBERRY BOG	610421 INTERMITTENT POND
115 FLATS	111608 MARSH-SALT	612111 SUBMERGED MARSH
116 BAY/ESTUARY/GULF	111612 MARSH-SUBMERGED	619101 RESERVOIR
122 MDC RESERVOIR	114007 CRANBERRY BOG	619412 STREAM
124 FILTRATION POND	114111 CRANBERRY BOG/MARSH	619421 LAKE OR POND
300 SPRING	115007 FLATS	101111612 SUBMERGED RES MARSH
400 RAPIDS	115020 FLATS	101619625 ESERVOIR
401 FALLS	115116 FLATS/BAY	105007111 INUN AREA/MARSH
402 GRAVEL PIT W/WATER	115410 FLATS/ROCK	105111007 INUN AREA/MARSH
404 PUMPING STATION	115412 FLATS/STREAM	111007105 MARSH/INUN AREA
406 DAM/WEIR	115421 FLATS/POND	111007612 MARSH-SUBMERGED
408 SPILLWAY	115422 FLATS/CORAL REEF	111007625 MARSH/WETLAND
410 ROCK	115616 FLATS-NAVIGABLE	111105007 MARSH/INUN AREA
411 CREVASSE	406618 DAM-EARTHEN	111114007 MARSH/CRANBERRY BOG
412 STREAM	410115 ROCKS/FLATS	111612007 MARSH-SUBMERGED
414 DITCH/CANAL	411007 CREVASSE	111612421 POND MARSH-SUBMERGED
415 AQUEDUCT	412111 STREAM/MARSH	111612619 MARSH-SUBMERGED
416 FLUME	412115 STREAM FLATS	111612625 MARSH-SUBMERGED
419 CHANNEL IN WATER	412612 STREAM-SUNKEN	114007111 CRANBERRY BOG/MARSH
421 LAKE OR POND	415604 AQUEDUCT-TUNNEL	114111007 CRANBERRY BOG/MARSH
422 CORAL REEF	419115 CHANNEL FLATS	421111007 POND MARSH
999 LAND/ISLAND	419616 CHANNEL-NAVIGABLE	421619625 LAKE OR POND
7105 INUNDATION AREA	421007 LAKE OR POND	421625619 LAKE OR POND
7111 MARSH/WETLAND	421101 POND/RESERVOIR	619625415 AQUEDUCT
101619 RESERVOIR	421111 POND WETLAND	619625421 LAKE OR POND
101625 RESERVOIR	421609 UNSURVEYED POND	101111612625 RES MARSH-SUBMERGED
102111 COV RESERVOIR/MARSH	421610 POND-INTERMITTENT	

The following table lists all the possible codes for an **ARC FEATURE** in the .AAT. These codes have been extracted and concatenated from the USGS DLG major/minor pairs. The digitized and enhanced hydrography quadrangles do not have the same level of coding.

MINOR_NUM DESCRIPTION	MINOR_NUM DESCRIPTION	MINOR_NUM DESCRIPTION
109 SEWAGE DISP/FILT BED	200606 LEFT BANK/ShORE	415601 AQUEDUCT-UNDERGROUND
200 SHORELINE	200610 INTERMITTENT SHORE	415604 AQUEDUCT-TUNNEL
201 MANMADE SHORELINE	201002 MANMADE SHORELINE	415605 AQUEDUCT RIGHT BANK
202 CLOSURE LINE	201009 MANMADE SHORELINE	415611 AQUEDUCT-ABANDONED
203 INDEFINITE SHORELINE	201020 MANMADE SHORELINE	415612 AQUEDUCT-SUBMERGED
204 APPARENT LIMIT	201605 MANMADE RIGHT BANK	601412 UNDERGROUND STREAM
211 UPLAND TRANSPORT ARC	201606 MANMADE LEFT BANK	605009 RIGHT BANK
300 SPRING	202412 CLOSURE LINE/STREAM	605201 RIGHT BANK-MANMADE
401 FALLS	203625 INDEFINITE SHORE	606009 LEFT BANK
405 WATER INTAKE	203627 INDEFINITE SHORE	606201 LEFT BANK-MANMADE
406 DAM/WEIR	204007 APPARENT LIMIT	610200 INTERMITTENT SHORE
407 CANAL LOCK	204009 APPARENT LIMIT	610412 INTERMITTENT STREAM
408 SPILLWAY	406009 DAM/WEIR	610414 INTERMITTENT CANAL
409 GATE	406017 DAM/WEIR	610421 INTERMITTENT POND
412 STREAM	406618 DAM/WEIR-EARTHEN	200618406 SHORE/EARTHEN DAM
414 DITCH/CANAL	412007 STREAM	201009020 MANMADE SHORE
415 AQUEDUCT	412009 STREAM	201020002 MANMADE SHORE
416 FLUME	412020 STREAM	201020605 MANMADE RIGHT BANK
419 CHANNEL IN WATER	412202 STREAM CLOSURE LINE	201605020 MANMADE RIGHT BANK
422 CORAL REEF	412601 STREAM-UNDERGROUND	201606009 MANMADE LEFT BANK
605 RIGHT BANK	412604 STREAM-TUNNEL	201606020 MANMADE LEFT BANK
606 LEFT BANK	412609 STREAM-UNSURVEYED	202412617 CLOS LINE/STR UNDERP
999 UNKNOWN OR NEAT LINE	412610 STREAM-INTERMITTENT	406009017 DAM/WEIR
7204 APPARENT LIMIT	414009 DITCH/CANAL	406618017 DAM-EARTHEN
9606 LEFT BANK	414017 DITCH/CANAL	406618200 DAM-EARTHEN/SHORE
200009 SHORELINE	414610 CANAL-INTERMITTENT	412610009 STREAM-INTERMITTENT
200201 MANMADE SHORELINE	414611 CANAL-ABANDONED	412610202 INT STREAM CLOSURE
	415412 AQUEDUCT/STREAM	412610617 INT STRM UNDERPASS

## Hydrography (1:100,000) Datalayer

### August 2000

#### OVERVIEW

MassGIS has adapted and modified the USGS 1:100,000 Hydrography Digital Line Graph (DLG) quadrangle files to produce two core elements-

- ponds and lakes (approx. 3,500 polygons)
- streams and rivers (approx. 7,300 arcs)

Due to the size of the datalayers, ponds and streams were originally split into five panels: WEST, MID, EAST, SE, and ISLE. To avoid unnecessary splitting of features, these panels follow major drainage divides. The five panels were condensed to four panels (**WEST, MID, EAST** and **SE**) by combining ISLE with SE to simplify usage of this datalayer. In addition, ponds and streams are now in a single coverage for each panel. Upon moving the database to Librarian, the data was repaneled by major basin groupings (*refer to Basin Index map at the back of this document*). The coverage name is now **HD100\_<num>** where <num> represents the tile unit of the basin index.

The coastline, the other major hydrography feature taken from the DLGs, was appended to the manually digitized community boundaries to create TOWNS, a MassGIS political boundary datalayer.

#### PRODUCTION

The DLG quad files were reformatted into Arc/INFO coverages and projected into the Mass. State Plane Coordinate system. The DLGs include extensive attributes that identify feature types (Minor Code 412 = Stream, 421 = Pond, etc.).

Wetlands were not extracted from the DLGs since more complete data is available from the 1:25,000 land use datalayer.

#### EDITING

After the features were sorted on attribute, the individual quad coverages were edgematched into five panels based on drainage basins (see index map). Proofplots were produced and compared to the paper 1:25,000 quads. The 1:100,000 hydrography DLGs were found to be significantly generalized in comparison with the 1:25,000 paper quads. Many small ponds and streams were not automated by USGS. Approximately 30% of the minor streams and 20% of the minor ponds are missing from the 1:100,000 DLGs.

Lines in the DLGs are less detailed than their 1:25,000 counterparts. These differences are not considered 'errors'.

Actual errors were noted and corrected. For example, braided streams and wetlands were sometimes incorrectly coded as ponds. Edges where two blocks of 32 quads met (a USGS defined unit of production) often did not match. In these cases, streams and ponds were digitized or moved as needed to complete the edgematching process.

MassGIS attributed most of the ponds with a PALIS-ID in the .PAT. The DFWELE GIS program attributed the named streams in the .AAT with a SARIS-ID with some additions to the PALIS-ID in the .PAT. Additional streams and ponds under study by the Division of Fisheries and Wildlife biologists which were not present in the 100k coverage were pulled from the 25k hydro data layer and attributed appropriately. In cases of a perched wetland, where the stream appeared to be connected to two river systems because the arc was continuous through the wetland, the DFWELE GIS program removed a tiny sliver of arc. In this way when the streams are plotted they would appear to flow out towards the major tributary. In the .PAT where the polygon is labeled a double-lined stream the SARIS-ID is being used as the PALIS-ID. This enables the stream to be shaded in

rather than just outlined.

## ATTRIBUTES

The .PAT contains the following items:

<b>NAME</b>	the name of the feature
<b>TYPE</b>	character item- P = Pond, DS = Doubleline River, I = Island
<b>FEATURE</b>	numeric item- 1 = Pond, 2 = Doubleline River, 3 = Island
<b>PALIS-ID</b>	a unique ID from the Ponds & Lakes Information System (60% to 70% of ponds have a PALIS number)
<b>BAS-ID</b>	major basin code number- see MAJ-BAS datalayer description

The .AAT contains the following items:

<b>SARIS-ID</b>	a unique ID from the Streams & Rivers Information System
<b>BAS-ID</b>	the major basin id#
<b>FEATURE</b>	numeric item - 1 = Shore, 2 = River, 3= Doubleline River Shore

The ponds/lakes feature name and PALIS-ID were obtained from the UMass Water Resources Research Center. Additional ponds/lakes feature names and PALIS-IDs were obtained from the Division of Fisheries and Wildlife. The SARIS-ID was obtained from the Massachusetts Stream Classification Program, PART I: Inventory of Rivers and Streams (publication #14380-139-150-3-86-CR). A complete listing of stream names and their saris-ids can be found in the SARIS.LUT. A complete listing of pond/lake names and their PALIS-IDs can be found in the PALIS.LUT.

## ANNOTATION

Names of ponds and streams have been added for cartographic display purposes. There are approximately 6,000 names, taken from the USGS 1:25,000 quads. The letters are 450 feet high (roughly 137 meters), which makes the annotation useful for output scales ranging from 1:50,000 to 1:100,000. The annotation is in two layers; layer one contains the stream names, and layer two contains the pond names.

## MAINTENANCE

Maintained by MassGIS and the DFWELE GIS program.



## Major Ponds and Major Streams Datalayers

July 1998

### OVERVIEW

The Major Ponds and Major Streams datalayers represent a subset of hydrographic features from the 1:100,000 Basin-tiled HD100 layer. Large water bodies and rivers are included in these two layers, respectively, and are meant to be used for plotting small-scale maps. Both are stored as single statewide datasets: **MAJ\_POND** and **MAJ\_STRM**.

### PRODUCTION

The data were taken from the more detailed 1:100,000 hydrography layer, which was developed from the US Geological Survey's National Marine Division 1:100,000 digital line graphs (DLGs). The determination of which features should be considered "major" was made by M. Frimpter, Chief Hydrologist for the USGS.

### ATTRIBUTES

The MAJ\_POND layer has a polygon attribute table (.PAT) with the following items:

ITEM NAME	WIDTH	OUTPUT	TYPE	
TYPE	2	2	C	Hydrographic feature type (character code): P = Pond DS = Double line river/stream I = Island
FEATURE	2	2	B	Hydrographic feature type (numeric code): 1 = Pond 2 = Double line river/stream 3 = Island
PRIMARY	1	1	I	Place-holder; codes have no meaning

The MAJ\_STRM layer has an arc attribute table (.AAT) with the following item:

ITEM NAME	WIDTH	OUTPUT	TYPE	
PRIMARY	1	1	I	All arcs are streams coded "1"

### MAINTENANCE

MassGIS is maintaining these layers.

## Orthophoto Wetlands and Streams (1:5,000) Datalayers

June 2001

### OVERVIEW

The Orthophoto Wetlands and Streams datalayers comprise a polygon coverage and a line coverage. They are registered to, and tiled by, the Orthophoto Quad Library. The attribute codes in the WETLANDS polygon coverage describe different types of wetland environments. The Wetlands polygon coverages are named **W** and compose the **WETLANDS** layer. The arcs in the line coverages, which are named **S**, represent streams and compose the **STREAMS** layer.

### METHODOLOGY

The wetlands were interpreted from stereo, 1:12000 scale, color-infrared photography by staff at UMASS Amherst. The interpretation is field-checked by Department of Environmental Protection (DEP) Wetlands Conservancy Program (WCP). Completed interpretations are then scanned. The resulting images are converted to ARC/INFO coverages. The distortion from terrain and camera coordinates are removed using a photogrammetry software program, and a digital terrain model (DTM) derived from 1:5,000 black and white ortho-rectified digital aerial photography. The corrected coverages are then mapjoined and clipped by the boundary of a State Plane Coordinate grid cell which represents a 4-km. by 4-km. orthophoto sheet. Plots are generated at 1:5000 scale and final quality control is performed at that scale. It should be noted that the resulting wetlands are for planning purposes only; final wetland boundary determination must accord with MA Act M.G.L. c. 131.

### ATTRIBUTES

Attributes for each W wetlands coverage is stored in an ARC/INFO .PAT (Polygon Attribute Table) with these items:

ITEM NAME	WIDTH	OUTPUT	TYPE	N.DEC	DESCRIPTION
WETCODE	4	5	B	-	WETLAND CONSERVANCY CODES
ITEM_VALUE_C	12	12	C	-	WETLAND LABEL ABBREVIATIONS
ITEM_VALUE_DESC	60	60	C	-	DESCRIPTION OF WETLAND LABELS

The following types of wetlands are represented in the datalayer:

WETCODE	ITEM VALUE C	ITEM VALUE DESC
1	BA	COASTAL BANK BLUFF OR SEA CLIFF
2	BB	BARRIER BEACH SYSTEM
3	BE	COASTAL BEACH
4	BG	BOG
5	CB	CRANBERRY BOG
6	D	COASTAL DUNE
7	DM	DEEP MARSH
8	M	SHALLOW MARSH MEADOW OR FEN
9	OW	OPEN WATER
10	RS	ROCKY INTERTIDAL SHORE
11	SM	SALT MARSH
12	SS	SHRUB SWAMP
13	TF	TIDAL FLAT
14	WS1	WOODED SWAMP DECIDUOUS
15	WS2	WOODED SWAMP CONIFEROUS
16	WS3	WOODED SWAMP MIXED TREES
17	BB-BE	BARRIER BEACH-COASTAL BEACH
18	BB-BG	BARRIER BEACH-BOG
19	BB-D	BARRIER BEACH-COASTAL DUNE
20	BB-DM	BARRIER BEACH-DEEP MARSH
21	BB-M	BARRIER BEACH-MARSH
22	BB-OW	BARRIER BEACH-OPEN WATER
23	BB-SS	BARRIER BEACH-SHRUB SWAMP
24	BB-WS1	BARRIER BEACH-WOODED SWAMP DECIDUOUS
25	BB-WS2	BARRIER BEACH-WOODED SWAMP CONIFEROUS
26	BB-WS3	BARRIER BEACH-WOODED SWAMP MIXED TREES
88	N/A	N/A
99	U	UPLAND

An **.AAT** (Arc Attribute Table) exists in the Wetlands polygon coverage. Lines may be coded:

9999	represent the edge of a N/A, or not-interpreted area.
7777	represents a coastal area or approximate mean low water.
0	represents the edge of the orthophoto quadrangle area.

The stream coverages contain an .AAT without additional attributes. All arcs represent streams.

## MAINTENANCE

These datalayers are being developed by DEP GIS group. Distribution is through MassGIS. Questions may be directed to DEP GIS to 617-574-6890.

The datalayers are currently under development. Data production is complete in the Wachusett, Ware, Quabbin, Shawsheen, North Coastal, Ipswich, Merrimack, Parker, Cape Cod and Islands basins. A large part of the Metro Boston area and Buzzards Bay basin are also complete. Production of additional wetlands data is underway in the southeastern part of the state. Please consult the current project status map at [http://www.state.ma.us/mgis/st\\_wet.htm](http://www.state.ma.us/mgis/st_wet.htm) for the most up-to-date availability.

## National Wetlands Inventory Datalayer

April 2000

### OVERVIEW

The National Wetlands Inventory (NWI) project, administered by the U.S. Fish and Wildlife Service, was established to generate information about the characteristics, extent and status of the Nation's wetlands and deepwater habitats. Federal, State, and local agencies, academic institutions, the U.S. Congress, and the private sector use this information. The Emergency Wetland Resources Act of 1986 directs the Service to map the wetlands of the United States. The NWI has mapped 89% of the lower 48 states, and 31% of Alaska. The Act also requires the Service to produce a digital wetlands database for the United States. About 39% of the lower 48 states and 11% of Alaska are digitized. Approximately 50 percent of Massachusetts is available in digital format. For full details on the national mapping project visit the National Wetlands Inventory web site (<http://www.nwi.fws.gov/>).

The datalayer is named **NWI** and is stored in the **QUAD2** library. Each USGS quad-tiled coverage is named **NWI**.

### PRODUCTION

MassGIS downloaded all individual 7.5-minute quad-tiled coverages site that cover Massachusetts from the NWI web. Processing included projection from Universal Transverse Mercator (UTM) to Mass. State Plane Mainland, NAD83 meters. Quality assurance was performed for attribute consistency and the data were placed into the QUAD2 library. Information on the original production of the data may be found in the NWI FGDC Metadata.

### ATTRIBUTES

This layer contains polygon features representing various wetlands and deepwater habits and arcs representing rivers and streams. Each **NWI.PAT** (polygon attribute table) contains the following items:

**ATTRIBUTE** - Wetlands classification as interpreted by NWI

**POLY\_CODE** - Generalized wetland class for plotting purposes, derived by MassGIS:

- 0 = Upland (non-wetland areas)
- 1 = Predominantly Open Water
- 2 = Estuarine, sub-tidal Marine Systems
- 3 = Estuarine, intertidal
- 4 = Non-tidal, aquatic bed
- 5 = Non-tidal, emergent vegetation
- 6 = Forested wetlands
- 7 = Non-tidal, scrub-shrub
- 8 = Non-tidal, unconsolidated shore
- 9 = Non-tidal, farmed land, bogs
- 10 = Tidal, channels

The **POLY\_CODE** item was created to facilitate mapping and combines several values of the **ATTRIBUTE** field, as follows:

<u>POLY_CODE</u>	<u>Contains 'ATTRIBUTE' values that begin with:</u>
0	U
1	L1, L2, PUB, R2, R3, R5
2	E1, M
3	E2
4	PAB
5	PEM
6	PF, PR
7	PSS
8	PUS
9	Pf
10	R1

Complete definitions of the NWI 'ATTRIBUTE' codes are contained in the document `nwi_def.doc` (available for download at [http://www.state.ma.us/mgis/nwi\\_def.doc](http://www.state.ma.us/mgis/nwi_def.doc) in Microsoft Word 97 format). The text file [http://www.state.ma.us/mgis/nwi\\_clas.txt](http://www.state.ma.us/mgis/nwi_clas.txt) contains a chart showing the

hierarchy of the NWI Wetlands and Deepwater Habitats Classification scheme.

Each **NWLAAT** (arc attribute table) contains the following items:

**ATTRIBUTE** - Wetlands arc classification as interpreted by NWI

**ARC\_CODE** - Generalized wetland class for plotting purposes, derived by MassGIS:

0 = Polygon boundaries

1 = Rivers and streams

#### MAINTENANCE

MassGIS provides these data for use with other data in Mass. State Plane projection and does not maintain or update the database. Data not currently in digital format will be added to our library when made available by NWI. For available data see [http://www.state.ma.us/mgis/st\\_nwi.htm](http://www.state.ma.us/mgis/st_nwi.htm).

## Public Water Supplies Datalayer

March 2001

### OVERVIEW

The statewide Public Water Supply (PWS) datalayer (**PWS\_DEP**) contains public community surface and groundwater supplies, as defined in 310 CMR 22.00, and 1528 public non-community sources.

The DEP PWS datalayer has been compiled from several sources. The original DEP PWS point dataset contained only community water supplies (CWS) which were located and digitized from stable mylar overlays based on USGS topographic quadrangles. In 1993 locations for approximately 2360 community and non-community sources were generated from global positioning system (GPS) data collected by the U.S. Environmental Protection Agency (EPA). The EPA GPS locations were merged with the existing DEP CWS point data to create the DEP PWS datalayer. From June 1996 to February 1997 the DEP GIS Program and Drinking Water Program (DWP) conducted an intensive update of the PWS datalayer. This update involved several sources including GPS field verification and resulted in the addition of 665 sources to the DEP PWS datalayer.

As stated in 310 CMR 22.00, a Community Water Supply is part of a community water system "which serves at least fifteen (15) service connections used by year-round residents or regularly serves at least twenty-five (25) year-round residents." A Non-Community Water Supply is defined as a single service connection that is potentially available to 25 or more persons, such as a school, factory or restaurant. Non-Community Water Supplies are further defined as being Transient or Non-Transient based on the usage period, with less than 6 months use on a yearly basis being considered Transient.

### DATA SOURCES

Public water supply source locations in the PWS datalayer have been compiled from a variety of data sources including field verification using GPS and traditional office based cartographic methods.

#### **Field Verification:**

The DEP PWS datalayer contains field-verified data developed from the following formats:

- GPS verified point data collected by EPA and DEP staff, differentially corrected (DGPS - optimal accuracy +/- 2-5 meters) and converted into Arc/INFO point features.
- Field-verified locations based on uncorrected GPS data.

#### **Manuscript Maps:**

PWS sources were either compiled by DEP technical staff on stable mylar overlays based on USGS (1:25,000) topographic quadrangle maps or directly onto one of the following GIS generated manuscript maps:

- MassGIS vector data-based map
- MassGIS USGS topographic image-based map
- MassGIS Black and White orthophoto image-based map

#### **Coordinate Data:**

Coordinate data provided by DEP DWP technical staff is projected to (NAD83) Massachusetts mainland state plane meters and used to generate PWS source locations.

### METHODOLOGY

US EPA field-verified DGPS locations were provided in a digital format and converted into an Arc/INFO point coverage. Attributes from DWP water systems yearly reporting forms were then attached to the points. The original DEP CWS coverage was automated by DEP staff using traditional methods of tablet digitizing source locations on stable mylar overlays of USGS topographic quadrangles. Spatial and attribute data that existed in the CWS datalayer were then merged with the DGPS based PWS data to create the **PWS\_DEP** datalayer.

Updated PWS point data were appended to **PWS\_DEP** from a variety of sources including GPS mapping, manually and digitally compiled base maps, coordinate data and photo-interpretation. DEP staff used Trimble Navigation Ltd. Pathfinder Professional and GeoExplorer GPS receivers to field verify missing sources. Trimble GPS receiver parameters were configured to achieve +/- 2- to 5-meter accuracy positions with differential correction.

DEP mapped DGPS positions were differentially corrected using base station data from EOE's Pathfinder Community Base Station. DEP DGPS data were generated into Arc/INFO (NAD83 meter) point coverages and quality checked using MassGIS digital USGS topographic images and hand sketched locus maps provided by DEP field staff. Office checked data were compiled onto 1:25,000 GIS generated paper manuscripts, by DWP technical staff and digitized by GIS Program staff, using on screen technique. Coordinates (UTM and Lat/Long), verified and provided by DWP technical staff were projected to Massachusetts State Plane Coordinates (NAD 1983 meters), generated into ARC/INFO point coverages and merged with existing PWS point data. The DEP GIS Program also used .5 meter digital orthophoto images (1:5,000) to QC and refine community PWS wells, by locating the pumphouse on the orthophoto and adjusting the source location.

## ATTRIBUTES

The DEP Water Quality Testing System (WQTS) database is the Department's central database for tracking water supply data. Data downloaded from WQTS is related to the PWS datalayer by the SOURCE-ID item and is used to populate attributes in the PWS datalayer.

The **PWS\_DEP** datalayer has a point attribute table (.PAT) with the following items:

SOURCE-ID	DWP assigned PWS source identifier (first 7 digits conform to PWSID) The SOURCE-ID is used to relate PWS source locations to WQTS and other DWP maintained databases. The SOURCE-ID is generally unique, except for proposed wells (PW) which have not been officially approved and assigned an official SOURCE-ID. The SOURCE-ID for PW sources usually is the PWSID (see: redefined items below).
TOWN	Town in which the source is located
COUNTY	County in which the source is located
QUAD-NAME	USGS (7.5 minute – single) quadrangle name in which the source is located
BAS-ID	MassGIS ID indicating the major drainage basin in which the source is located
SITE-NAME	For community sources this is the source name (S_NAME) as listed in WQTS, for non-community Sources this is the public water supply name (PWS_NAME) as listed in WQTS. For proposed sources, which are not tracked in WQTS, this is the source name as submitted to the DEP GIS Program by DWP.
LATITUDE	Latitude in decimal degrees, Clarke1866 Spheroid, NAD27 (actual)
LONGITUDE	Longitude in decimal degrees, Clarke1866 Spheroid, NAD27 (actual)
TYPE	PWS Source Type: GW = groundwater PS = proposed surface water PW = proposed SW = surface water TNC = Transient Non-Community SD = source distribution NTNC = Non-Transient Non-community
SOURCECHK	Status of coverage data source quality check: GPS = Differentially corrected GPS data (2-5 meter accuracy) FC = Field verified by DEP technical staff, using uncorrected GPS data OC = Located using USGS (1:25,000) topographic quadrangle data or GIS generated vector data basemap PHO = Photo-interpreted from .5 or 1 meter resolution digital orthophoto images UNK = Source unknown
ZII-NUM	DEP DWP assigned ID number of Zone II associated with the source. Corresponds to the ZII-NUM item in the region subclass table (ZONE_II.PATZONE2) of the ZONE_II datalayer
GPM	Yield in gallons per minute (GPM): GPM = 0 indicates a pumping rate < 70 gpm GPM = 70 indicates a pumping rate of > 70 gpm (100,000 gpd)
WSPP	Water Supply Protection Plan (Y = yes)
QUADSID	MassGIS USGS quad ID in which the source is located
REG_OBJ_ID	DEP Facility Master File (FMF) Regulated Object ID – Unique Identifier
<b>** redefined items**</b>	
PWSID	DEP public water supplier or system iden. number (First 4 digits are DEP Region ID, followed by MassGIS Town ID)
REGION	DEP Region identification number: 1 = Western 2 = Central 3 = Northeast 4 = Southeast (corresponds to the first digit of PWSID and SOURCE-ID)
TOWN-ID	MassGIS Town identification number, corresponds to digits 2,3 and 4 of the PWSID and SOURCE-ID

The SOURCE-ID represents a well, well field, pumping station, or surface water withdrawal point source. In some instances the coverage will show a tightly grouped cluster of wells. Historically,

SOURCE-IDs were assigned to established water quality sampling locations. If a pumping station was the sampling point for a group of wells, it was assigned the SOURCE-ID, but if the individual well was sampled, the SOURCE-ID was given to each sampled well. A proposed source (PW) designates a test well or potential PWS that would require a new source approval to come on-line. Proposed sources have no assigned source identifier, but have a PWSID.

Be advised that at any time any of the PWS sources in this datalayer may be off-line for many reasons; no inference is made as to the condition of these sources. Please contact the appropriate water company for the latest status.

#### RELATED DATALAYERS

The DEP PWS datalayer is closely related to several important DEP water supply datasets.

##### **DEP Approved Wellhead Protection Areas (Zone II)**

PWS sources with assigned Zone IIs are related to the Zone II datalayer's Zone2 region subclass table by the item ZII-NUM (see: PWS\_DEP.PRL). Please note that in most cases there are more than one PWS source per Zone II.

##### **DEP Interim Wellhead Protection Areas (IWPA)**

Although there is no database relate between the PWS sources and the IWPA datalayer, it is important to always display IWPAs with DEP PWS point data on any map or project. The IWPA data is a simple Arc/INFO polygon coverage generated from buffering the PWS source locations based on pumping rate or DEP default values.

##### **DEP Surface Water Supply Protection Areas (Zone A, Zone B)**

DEP Zone A and Zone B surface water supply protection areas are related to the PWS source data by SOURCE-ID.

#### RELATED DATABASE FILES

Several related INFO database files are provided to maintain linkages with other DWP data sets and to provide information for calculating Interim Wellhead Protection Areas (IWPA) and Zone 1 Protection Areas based on PWS source pumping rates. The attached INFO relate file **PWS\_DEP.PRL** contains the relate environment for the PWS datalayer.

The file **PWS\_DEP.WQTS** contains information downloaded from the DWP Water Quality Testing System (WQTS) Oracle database. WQTS is DEP's comprehensive repository for PWS information. The WQTS database contains many other data items that are not in the **PWS\_DEP.WQTS** relate file. This table was designed for use by the DEP GIS Program to maintain the PWS datalayer in close relation to WQTS. Current items include:

PWSID	DEP water supplier identification number (see: PWSID description for PWS_DEP.PAT)
PWS_NAME	Water supplier name – conforms to SITE-NAME for non-community sources
PWS_CLASS	Source classification: COM = Community surface and groundwater sources NTNC = Non Transient Non Community NC = Transient Non Community
PWS_STATUS	Water supplier status (A = Active, I = Inactive)
SOURCE-ID	PWS source Identification number
S_NAME	Source name, conforms to SITE-NAME for community sources
S_STATUS	Source status (A = Active, I = Inactive)
S_AVAILABI	Source availability (ACTIVE, INACT, EMERG, ABAND), abandoned (ABAND) sources are <u>NOT</u> maintained in PWS_DEP

Only sources coded in WQTS as having Active (ACTIVE), Inactive (INACT) or Emergency (EMERG) availability (see: **S\_AVAILABI** field) are maintained in **PWS\_DEP**. Sources listed as abandoned (ABAND) in WQTS are removed from the PWS datalayer. Sources in WQTS that are coded as abandoned include both abandoned and decommissioned wells. Abandoned sources are no longer in use or are otherwise unfit for the purposes of water supply. Abandoned sources have been physically disconnected from the distribution system but have not undergone DEP's formal decommissioning process. Decommissioning requires physically rendering the source incapable of water supply.

The file **PWS\_DEP.Z2DAT** contains information from the DEP DWP Zone II Tracking database.



## Items include:

TOWN	Town in which the PWS source is located
WELLNAME	Source name
PURVEYOR	Water supplier name
BASIN	Major drainage basin in which the PWS source is located
REGION	DEP Region identification number: 1 = Western 2 = Central 3 = Northeast 4 = Southeast
SOURCE-ID DEP	PWS source ID (see: SOURCE-ID description for PWS_DEP.PAT)
ZII-NUM	Number of the Zone II (assigned by DEP DWP) delineated for the PWS source
METHOD	Method in which the Zone II was delineated
AQUIFER	Type of aquifer that comprises the Zone II
PROGRAM	DEP DWP program under which the Zone II was approved
SUB_DATE	Date the Zone II was submitted to DEP DWP for approval
APP_DATE	Date that the Zone II was approved
RATE_GPM	Source pumping rate in gallons per minute (GPM)
STATUS	Current Zone II status (C = Current, S = Superseded)
SYSTEM	PWS Classification (COMM – Community, NC – Non Community, N/A)
WHP_CNTRL	Existing wellhead protection plan (Y = Yes, N = No)
BYLAW_DATE	Date of Bylaw approval containing well head protection plan

The file **PWS\_DEP.SWP-BASINS** links PWS surface water supply (SW) sources to the MassGIS drainage sub-basins datalayer using the item SUB-ID. Items include:

SOURCE-ID	DEP PWS source ID (see: SOURCE-ID description for PWS_DEP)
REG_OBJ_ID	DEP Facility Master File (FMF) Regulated Object ID – Unique Identifier
SUB-ID	Drainage sub-basin identification number that contributes to the surface water supply
<b>** redefined items **</b>	
REGION	DEP Region identification number in which the surface water supply intake is located: 1 = Western, 2 = Central, 3 = Northeast, 4 = Southeast
TOWN-ID	MassGIS town identification number in which the surface water supply intake is located
BAS-ID	MassGIS major drainage basin identifier (see: Major Drainage Basins) in which the surface water supply intake is located
PWSID	DEP public water supplier or system ID number (First 4 digits are DEP Region ID, followed by MassGIS Town ID)

The file **PWS\_DEP.DRS-BASINS** links direct river sources to the MassGIS drainage sub-basins datalayer using the item SUB-ID. Direct River Sources (DRS) are PWS surface water supplies with intakes located on Class B rivers. Items include:

SOURCE-ID	DEP PWS source ID (see: SOURCE-ID description for PWS_DEP)
SUB-ID	Drainage sub-basin identification number that contributes to the surface water supply
<b>** redefined items **</b>	
REGION	DEP Region identification number in which the surface water supply intake is located: 1 = Western 2 = Central 3 = Northeast 4 = Southeast
TOWN-ID	MassGIS town identification number in which the surface water supply intake is located
BAS-ID	MassGIS major drainage basin identifier (see: Major Drainage Basins data layer documentation) in which the surface water supply intake is located
PWSID	DEP public water supplier or system iden. number (First 4 digits are DEP Region ID, followed by MassGIS Town ID)

## MAINTENANCE

The DEP GIS Program, in cooperation with DWP maintains this datalayer. Updates are made on a quarterly (Dec., Mar., June, and Sept.) basis, in accordance with the DWP's PWS new PWS source approval schedule. The updated datalayer is then shared through MassGIS.

## Aquifers Datalayer

March 1997

### OVERVIEW

MassGIS produced an aquifer datalayer composed of 20 individual panels, generally based on the boundaries of the major drainage basins. Areas of high and medium yield were mapped. These panels, which were retiled for Librarian, are called **AQ**. The layer is named **AQUIFERS**.

This datalayer includes polygon attribute coding to help in the identification of areas in which clean up of hazardous waste sites must meet drinking water standards, as defined in the Massachusetts Contingency Plan (MCP) (310 CMR 40.0000). A separate layer in the STATE library named **NPDWSACC** holds this data for Cape Cod (Non-Potential Drinking Water Source Areas for Cape Cod).

### MANUSCRIPT

The USGS 1:48,000 hydrologic atlas series on groundwater favorability was produced for all of Massachusetts. The basemaps for these were photographically reduced and spliced together from 1:24,000 USGS quadrangles. Each manuscript covers one of the major drainage basins. They have been individually researched and published by the USGS-WRD starting in the 1960's and continuing to the present. Several have been compiled but not yet published. In these cases the draft manuscripts were automated.

The definition of high and medium yield varies between panels, as it does on the source manuscripts. While the medium yield for most basins is between 100 and 300 gpm (gallons per minute), this range may vary greatly from basin to basin. High yield definitions vary from basin to basin as well. Yield for each panel is found in the metadata file AQ.SRC.

Entering the data in Librarian format modified the tiling scheme of this layer. The aquifers are now tiled by major basin grouping as illustrated in the Basin Index map at the back of this document. However, the original tiling scheme may be recovered by reselecting on the PANEL item in the .PAT.

### PRODUCTION

The high and medium yield categories were automated from the manuscripts. The major drainage basin boundary was copied from the MAJ\_BAS coverage to use as a template for digitizing. Because ponds and lakes are also closely related to aquifers, they were clipped from the ponds datalayer and also used as a template. The USGS manuscripts were not edgematched to adjacent panels; no attempt has been made to resolve interpretation inconsistencies between panels.

### ATTRIBUTES

Both a polygon attribute table (.PAT) and an arc attribute table (.AAT) were created for each aquifer panel. The AAT has one item called OUTLINE. The drainage basin boundary is coded as '1'. All other arcs are coded as '0'.

The **AQ<basin>.PAT** has the following ITEMS:

<b>CODE</b>	1=pond, 2=high yield, 3=medium yield
<b>TYPE</b>	character values the equivalent of the CODE item
<b>YIELD</b>	yield per minute for the aquifer classes
<b>TRANSMISSIVITY</b>	square feet per day
<b>AREA-ACRES</b>	area in acres of each polygon
<b>NPDWSA</b>	Non Potential Drinking Water Source Area
<b>PANEL</b>	original basin panel, used to identify source of aquifer data

For the purpose of identifying areas in which clean up of hazardous waste sites must meet drinking water standards, as defined in the Massachusetts Contingency Plan (MCP) (310 CMR 40.0000), the DEP has coded polygons within the aquifer coverage to identify "Non Potential Drinking Water Source Areas" (NPDWSAs).

NPDWSAs include any Potentially Productive Aquifer or portion thereof which underlies land areas of at least 100 acres developed for one or more of the following uses as of January 1, 1996: Industry; Commerce; Dense residential development and associated uses; Transportation; or Urban open space; and those portions of Potentially Productive Aquifers that underlie US Census block groups with population densities of greater than 4,400 persons/square mile. Polygons where the item NPDWSA = 1 are designated as NPDWSAs. Polygons where the item NPDWSA = 0 are not designated as NPDWSAs.

As defined in the MCP, a Potentially Productive Aquifer means all aquifers delineated by the USGS as high or medium yield, and all aquifers located east of the Cape Cod Canal (Cape Cod), on the Elizabeth Islands, on Martha's Vineyard, or on Nantucket.

NPDWSA polygons within the aquifer coverage were delineated by the DEP based on land use information in the MassGIS land use coverage and population density data from the 1990 US Census. Municipalities were given the opportunity to review the DEP's delineation of NPDWSAs prior to the September 1996 promulgation of the current MCP groundwater clean up regulations. The delineation of NPDWSAs in the aquifer coverage may reflect additional land use information provided by municipalities.

For more detailed information about the designation of NPDWSAs and the MCP, please contact the DEP MCP Helpline @ (617) 338-2255 or 1-(800) 462-0444.

The item PANEL stores the panel code identifying data sources and changes of the data from its original tiling scheme. Using the identifier PANEL as the link between the data and metadata, table AQ.SRC contains the AQ<coverage>.DOC records from the original, individual aquifer coverages. More than one record may exist per panel.

#### EDITING

Plots of each panel were made at a scale of 1:48,000 and compared to the source map. Corrections were made as needed.

#### MAINTENANCE

DEP and MassGIS maintain this datalayer.

## EPA Designated Sole Source Aquifers Datalayer

May 1996

### OVERVIEW

The Sole Source Aquifer datalayer was compiled by the Department of Environmental Protection (DEP) Division of Water Supply (DWS). Seven Sole Source Aquifers have been designated by the US Environmental Protection Agency (EPA) for Massachusetts. The Sole Source Aquifers are stored as a statewide polygon coverage, **AQ\_SOLE**. A Sole Source Aquifer (SSA) is an aquifer designated by US EPA as the 'sole or principal source' of drinking water for a given aquifer service area; that is, an aquifer which is needed to supply 50% or more of the drinking water for that area and for which there are no reasonably available alternative sources should that aquifer become contaminated.

### METHODOLOGY

The aquifers were defined by a EPA hydrogeologist. Aquifer boundaries were then drafted by EPA onto 1:25,000 USGS quadrangles. For the coastal sole source aquifers the shoreline as it appeared on the quadrangle was used as a boundary. Delineated boundaries were then digitized into Arc/INFO. However, to ensure that aquifer boundaries coincide with MassGIS coast data, the ARC RESELECT command was used to select the aquifer boundaries for Martha's Vineyard, Nantucket and Cape Cod SSAs. The coastal SSA boundaries are fluid and change with the change of shore line. Checkplots of the aquifers were submitted to US EPA Region 1 for verification.

### ATTRIBUTES

This datalayer has a **.PAT** with the following attributes associated with each polygon:

<b>SSA_NUM</b>	a unique id for each SSA
<b>SSA_NAM</b>	the name of the SSA
<b>SOURCE_CODE</b>	the source of SSA linework

Several small waterbodies also are found within this coverage. These have been coded with a SSA\_NAME of 'WATERBODY'.

### MAINTENANCE

The DEP Division of Water Supply and MassGIS are maintaining this datalayer.

## Major Drainage Basins Datalayer

March 1990

### OVERVIEW

MassGIS has produced a statewide digital datalayer of the 28 major drainage basins of Massachusetts as defined by the USGS Water Resources Division and the MA Water Resources Commission. This single statewide datalayer is called **MAJ\_BAS**.

### MANUSCRIPT

A set of 1:24,000 USGS paper quad sheets was carefully delineated with approximately 1800 minor or sub- drainage basins. This work was produced over the past 20 years by the USGS-WRD. Generally, the contours on the quads are the primary guide to basin boundaries. Often the 'mouth' of a basin is marked at the site of a stream gauging station, which can be different from the strict geographic location of the mouth.

### METHODOLOGY

The major basins were produced from the sub-basins using the Arc/INFO Dissolve command. This removed all lines except boundaries between major basins. This was possible because the Major Basin # is encrypted in the Sub-Basin-ID. The resulting Massachusetts internal major basin boundaries were then Appended to the state outline and shoreline, and processed to result in a statewide polygon datalayer, which is a digital facsimile of the Massachusetts Water Resources Commission official Massachusetts Drainage Basins Map. All sub-basins on the manuscripts were digitized (refer to SUB-BASINS Datalayer description). Due to good manuscript quality, including the visual edgematching of the 189 sheets, digitizing and edgematching was straightforward. The manuscript author was consulted on the minor errors and ambiguities that were discovered. Each panel was plotted at 1:48,000 and compared to the digitizing manuscript.

### ATTRIBUTES

The **MAJ-BAS.PAT** (Polygon Attribute Table) contains 258 polygons because of the many coastal islands. Items in the .PAT include:

<b>SQ. MILE</b>	of each polygon
<b>AREA-ACRES</b>	of each polygon
<b>BAS-ID</b>	maj-bas numbers 1 to 28
<b>NAME</b>	each major basin has a name

#### KEY TO THE MAJOR BASIN NUMBERING SYSTEM

1	Hudson	15	Shawsheen
2	Housatonic	16	Parker
3	Deerfield	17	Ipswich
4	Westfield	18	North Coastal
5	Farmington	19	Boston Harbor
6	Connecticut	20	Charles
7	Millers	21	South Coastal
8	Chicopee	22	Cape Cod
9	Quinebaug	23	Islands
10	French	24	Buzzards Bay
11	Nashua	25	Taunton
12	Blackstone	26	Narragansett Bay & Mt. Hope Bay Shore
13	Merrimack	27	Ten Mile
14	Concord		

The Major Basin.AAT contains an item called OUTLINE. This enables the state border and shoreline to be differentiated from interior lines. This enables a different line type to be used for the outline of the state. Basin names exist in two different annolevels. Level 1 uses **Textset Carto**; Level 2 uses **Textset Plotter**.

### MAINTENANCE

MassGIS is maintaining this datalayer.

## Drainage Sub-basins Datalayer

March 2001

### OVERVIEW

MassGIS has produced a statewide digital datalayer of the approximately 2300 sub-basins as defined and used by the USGS Water Resources Division and the Mass Water Resources Commission and as modified by Executive Office of Environmental Affairs (EOEA) agencies. These sub-basins were aggregated together to make the 28 basins of the Major Basins Datalayer. The **SUB\_BASINS** layer is stored in the BASIN library; coverages are named **SUBBAS** (*refer to Basin Index map at the end of this document*). Cape Cod and the Islands do not have much lateral 'surface' drainage because the soils are so porous. The sub-basin line shown for Cape Cod is the approximate groundwater divide between Cape Cod Bay, Vineyard Sound, and the Atlantic Ocean, taken from sub-surface groundwater contours. The state coastline and boundaries are included in the sub-basin coverages and are differentiated by arc attributes.

### MANUSCRIPT

A set of 1:24,000 USGS paper quad sheets was delineated into approximately 2200 minor or drainage sub-basins. This work was produced over the past 20 years mainly by the USGS-WRD. Generally, the contours on the quads are the primary guide to basin boundaries. Often the 'mouth' of a basin is marked at the site of a stream gaging station, which can be different from the strict geographic location of the mouth.

### METHODOLOGY

All sub-basins on the manuscripts were digitized. Due to good manuscript quality, including the visual edgematching of the 189 sheets, digitizing and edgematching was straightforward. The manuscript author was consulted on the minor errors and ambiguities that were discovered.

Drainage boundaries added to Cape Cod were created by the Massachusetts Bays Program (the boundary separating drainage between Nantucket Sound/Cape Code Bay/Atlantic Ocean) and the Buzzards Bay Project (the boundary separating drainage between Buzzards Bay and Nantucket Sound/Cape Code Bay). The subdivisions were created by delineating groundwater divides using the 1:48,000 scale USGS Hydrologic Atlas Series maps. The delineations were reviewed for consistency by the USGS Water Resources Division, but they are not considered official basins of the USGS or the MA Water Resources Commission.

In the fall of 1992 the MA Department of Environmental Protection Division of Water Supply added the state boundary and 1:100,000 coastline and extended or clipped the sub-basins to meet them. Additional drainage basins were delineated at the intake points of public water supplies. From these additional basins all upstream basins were coded as contributing to a surface public water supply. DEP regional staff determined which water supplies were primary and which were emergency or backup supplies, and the MDC provided the basins covered by MDC/MWRA jurisdiction.

### ATTRIBUTES

Each drainage sub-basin has a unique 5-digit SUB-ID number that was derived from the numbering system on the manuscripts. The numbers are roughly hierarchically ordered based on the sub-basin's position within the major basin. The ID-numbers ascend as the water descends. The first two numbers in the 5-digit code identify the 28 major basins as numbered in Massachusetts (see listing in the Major Basins Datalayer Description). This 2-digit code is duplicated in the (redefined) MAJ\_BAS ITEM. The last three numbers in the **SUB-ID** are duplicated in the **(redefined) POSITION** ITEM. Offshore islands are given a **SUB-ID** of ##999 where ## is the nearest onshore MAJ\_BAS ID.

The surface Water supply attribute, **WSP** is coded as follows:

<u>WSP</u>	<u>BASIN DESIGNATION</u>
0	Sub basin does not contribute to a Public Surface Water Supply
1	Public Surface Water Supply Watershed
2	Emergency/Backup Public Surface Water Supply Watershed
3	Adjacent State Surface Water Supply Watershed(incomplete)
4	MDC/MWRA Watershed
5	MDC/MWRA and Public Surface Water Supply Watershed

The arcs are coded with the two-digit attribute **LINE-ID**, which identifies the type of boundary the line represents:

<u>LINE-ID</u>	<u>LINE TYPE</u>
0	Sub-Basin Boundary
1	Major Basin Boundary
2	Coastline or State Boundary

#### EDITING

The entire datalayer was plotted at 1:100,000, selected areas at 1:25,000. Edgematching was done. The manuscript often had more than one ID per sub-basin. One was chosen by MassGIS. The water supply designation was plotted and checked by DEP regional staff.

#### MAINTENANCE

This datalayer is maintained by MassGIS.

## Major Watersheds Datalayer

June 2000

### OVERVIEW

MassGIS has produced a statewide digital datalayer of the 32 major watersheds covering Massachusetts as defined by the USGS Water Resources Division and the MA Water Resources Commission. The datalayer is called **WATRSHDS**. Unlike the MAJ\_BAS layer, the watersheds in this layer extend beyond the state boundary to include the full extent of each watershed. This layer is used as the index coverage for the WATRSHED and WATRSHD2 libraries (see the *Major Watersheds Index Map* at the back of this catalog).

### PRODUCTION

The WATRSHDS layer was originally based on the MAJ\_BAS layer and then modified to fit the needs of the MassGIS Watershed Analyst project. The state boundary was removed from MAJ\_BAS and the existing internal watershed boundaries were modified or adjusted to conform to the 1:25,000 Hydrography layer. To produce the watershed boundaries that extend beyond the state boundary, sub-basin data from the adjacent state GIS databases were incorporated. Some of these were adjusted to conform to the Networked Hydro Centerlines data, which was developed for use in the Watershed Analyst. These data are used for modeling stream flow. In some cases, the out-of-state sub-basins were clipped to include data that affect stream flow into or out of Massachusetts. In addition, the coastline was buffered for generalization. Non-contiguous basins, such as the two parts of the North Coastal watershed, were combined and connected with the coastal buffer to conform to the naming scheme as defined in the Stream and River Information System (SARIS).

### ATTRIBUTES

The **WATRSHDS.PAT** (Polygon Attribute Table) contains the following items:

<b>BAS-ID</b>	Corresponding ID in MAJ_BAS layer
<b>NAME</b>	each major basin has a name
<b>SARIS_NUM</b>	Watershed ID according to SARIS
<b>SQ_MI</b>	Area in square miles of each polygon
<b>AREA_ACRES</b>	Area in acres of each polygon

The **WATRSHDS.AAT** (Arc Attribute Table) contains an item called OUTLINE. Internal watershed boundaries are coded Outline = 0; exterior lines are code Outline = 1.

Watershed names exist as annotation, subclass NAME.

### MAINTENANCE

MassGIS is maintaining this datalayer.



## Watershed Analyst Datalayers

July 1999

### OVERVIEW

The WATRSBED library contains 32 tiles based on the SARIS (Streams and Rivers Information System) Ids of the major basins. Each tile name is a four-letter abbreviation of the basin name. The tiles are named as follows:

<u>SARIS ID</u>	<u>Major Basin Name</u>	<u>Tile Name</u>
11	Hoosic	HOOS
12	Kinderhook	KIND
13	Bashbish	BASH
21	Housatonic	HOUS
31	Farmington	FARM
32	Westfield	WEST
33	Deerfield	DEER
34	Connecticut	CONN
35	Millers	MILL
36	Chicopee	CHIC
41	Quinebaug	QUIN
42	French	FREN
51	Blackstone	BLAC
52	Ten Mile	TENM
53	Narragansett Bay	NARR
61	Mount Hope Bay	HOPE
62	Taunton	TAUN
71	Mystic	MYST
72	Charles	CHAR
73	Neponset	NEPO
74	Weymouth & Weir	WEYW
81	Nashua	NASH
82	Concord	CONC
83	Shawsheen	SHAW
84	Merrimack	MERR
91	Parker	PARK
92	Ipswich	IPSW
93	North Shore (N.Coastal)	NCOA
94	South Shore (S. Coastal)	SCOA
95	Buzzards Bay	BUZZ
96	Cape Cod	CAPE
97	Islands	ISLA

The WATRSBED library stores vector and raster data used in the MassGIS Watershed Analyst, an add-on suite of tools and menu choices in the MassGIS Data Viewer that allows for hydrological and watershed-based analysis within ArcView GIS. This page describes the data stored in the WATRSBED library for use with the Analyst.

### PRODUCTION and ATTRIBUTES

Each tile contains:

**cl\_** : The centerline coverage. It contains arcs, routes, and SARIS routes. The centerline was created and routed using a set of ARC/INFO AMLs from the 1:25,000 Hydrography as featured on the USGS topographic quads.

Each **CL\_.AAT** (arc attribute table) contains the following attributes:

<b>TILE-NAME</b>	name of SARIS major basin tile
<b>MINOR_TOT</b>	Type of water feature;Concatenated Digital Line Graph (DLG) codes
<b>SOURCE</b>	Data source for coverage (100K enhanced or 25K DLG)
<b>PWSID</b>	DEP PWS ID number of downstream Public Surface Drinking Water Supply
<b>CLASS</b>	Designated Use Classification (not yet implemented; Mass. Surface Water Quality Standards)
<b>ARC_CODE</b>	Generalized arc code derived from MINOR_TOT
<b>HYA</b>	Generalized arc code derived from MINOR_TOT
<b>RMIN</b>	Minor_num of polygon to right of arc
<b>LMIN</b>	Minor_num of polygon to left of arc
<b>RHYP</b>	Generalized arc code to right of arc
<b>LHYP</b>	Generalized arc code to left of arc
<b>CONNECTED</b>	Arcs that are in the route system
<b>SARISNAME</b>	Name of stream or river based on SARIS system
<b>ARCLINK#</b>	Links arc to its route in the section table
<b>T-MEAS</b>	Meters from mouth of routed major basin based on All route
<b>SARISCODE</b>	Stream code based on the SARIS (Stream and River Id System)
<b>** REDEFINED ITEMS **</b>	
<b>MINOR_NUM</b>	numeric version of MINOR_TOT

Each **CL\_RATRIVER** (river route attribute table) contains the following attributes:

<b>LENGTH</b>	Length of the route in meters
<b>ORDER</b>	Stream order (values 0-9 [no 1]) higher number = smaller tributary
<b>URA</b>	Id number of directly downstream route
<b>UMA</b>	Measure in meters that route branches off downstream route
<b>URB</b>	Id number of directly downstream route
<b>UMB</b>	Measure in meters that route branches off downstream route
<b>URC</b>	Id number of directly downstream route
<b>UMC</b>	Measure in meters that route branches off downstream route
<b>DRA</b>	Id number of directly upstream route
<b>DMA</b>	Measure in meters that route comes off of upstream route
<b>DRB</b>	Id number of directly upstream route
<b>DMB</b>	Measure in meters that route comes off of upstream route
<b>DRC</b>	Id number of directly upstream route
<b>DMC</b>	Measure in meters that route comes off of upstream route
<b>RIVER_NUM</b>	Statewide unique id number for route
<b>URAPX</b>	Copy of URA in character format
<b>URBPX</b>	Copy of URB in character format
<b>URCPX</b>	Copy of URC in character format
<b>DRAPX</b>	Copy of DRA in character format
<b>DRBPX</b>	Copy of DRB in character format
<b>DRCPX</b>	Copy of DRC in character format

**dbf directory:** Under the dbf directory are 3 types of files:

- ***mth.dbf*** - this file is a point event table of the mouth points of the subbasins
- ***mXX00?us.dbf, mXX00?ds.dbf*** - for each mouth point of the major basin, there is a file for upstream and downstream. The XX is the SARIS id of the major basin. The ? is filled starting with 1 for the various mouth points of the major basins. For example, the Housatonic has 2 mouth points, so the files in this directory include m21001us.dbf, m21001ds.dbf, m21002us.dbf, m21002ds.dbf. These files are linear event tables and could be viewed by the user, but are for upstream/downstream trace processing purposes.
- ***sg.dbf*** - for each subbasin (subid), the square miles of each type of surficial geology is listed (sg1 = code 1, etc, as listed in the Surficial Geology datalayer description). This table allows for quickly accumulating the upstream surficial geology values without having to clip a large area, making for a faster delineation. These sg.dbf tables are used only when the user wants to get lowflow statistics (not when just doing a simple delineation).

**odb directory:** *XX00?us.odb, XX00?ds.odb* - for each mouth point of the major basin, there is a file for upstream and downstream. The XX is the SARIS id of the major basin. The ? is filled starting with 1 for the various mouth points of the major basins. For example, the Housatonic has 2 mouth points, so the files in this directory include 21001us.odb, 21001ds.odb, 21002us.odb, 21002ds.odb. These files are for delineation processing purposes and cannot be viewed by the user.

**shps directory:** This directory contains ESRI shapefiles for the basin. Shapefiles contain three component files: *subbas.shp, subbas.shx, and subbas.dbf*, referring to the subbasin boundaries for the tile. These subbasins were taken from the BASIN library (basin.sub\_basins USGS subbasins), and modified slightly for technical reasons so that the watershed tools would complete delineations properly. Subbasins with no centerline were dissolved into adjacent subbasins, and some subbasin outlines were slightly modified so that the centerline was entirely contained within the subbasins. The small differences between the original subbasins coverage and the centerline coverage result from each dataset having been derived from different revisions of the USGS topographic maps.

**grds directory:** This directory contains 5 raster data files in ARC/INFO GRID format:

- ***clsg*** - A raster version of the cl\_ centerline coverage. Cell size is 10m. Integer grid. Values are 1 (centerline cells) and NODATA.
- ***dir2*** - A flow-direction grid developed by Pete Steeves of the USGS Water Resources Division, Northborough, Mass. Flow-direction data provides the direction in which the water flows from a cell. This grid was created from altered USGS elevation grids using a special process to "burn in" the centerline, essentially altering the terrain to better represent the hydrographic features. Cell size is 10m. Integer grid. Values include:

1 = East  
2 = Southeast

4 = South  
8 = Southwest  
16 = West  
32 = Northwest  
64 = North  
128 = Northeast

- ***elev*** – Elevation grids, derived from 1:25,000 USGS DEM data. Cell size is 30 meters, represented in standard feet values.
- ***slope250*** – Contributed by Pete Steeves of the US Geological Survey, Northborough, Mass. Derived from 1:250K DEM data. Slope is in percent. Cell size is about 94 meters.
- ***strg*** – A flow-accumulation grid created from the dir2 grid by the ARC/INFO GRID command strg = flowaccumulation(dir2). Cell size is 10m. Floating point grid.

## MAINTENANCE

These data datalayers are maintained by MassGIS. For information on data updates please contact Philip John by email at Philip.John@state.ma.us or by phone at (617) 626-1185.

For the latest data available for use in the Watershed Analyst, please see the current Status Map at [http://www.state.ma.us/mgis/st\\_wa.htm](http://www.state.ma.us/mgis/st_wa.htm).

When ordering a MassGIS Data Viewer that includes the above datalayers, choose the Data Viewer with Watershed Data option.

## Abandoned Cranberry Bogs Datalayer

March 1997

### OVERVIEW

The abandoned cranberry bogs datalayer was compiled by the Massachusetts Department of Environmental Protection (DEP) GIS Program from source material provided by the DEP Wetlands Conservancy Program (WCP). The data set **AB\_CRAN**, is a buffered point coverage containing the location of 537 abandoned cranberry bogs in 41 Massachusetts municipalities in Barnstable, Bristol and Plymouth Counties.

<u>BARNSTABLE COUNTY</u>	<u>BRISTOL COUNTY</u>	<u>PLYMOUTH COUNTY</u>
BARNSTABLE	ACUSHNET	BRIDGEWATER
BOURNE	BERKLEY	CARVER
BREWSTER	EASTON	DUXBURY
CHATHAM	FAIRHAVEN	EAST BRIDGEWATER
DENNIS	FREETOWN	HALIFAX
EASTHAM	LAKEVILLE	HANOVER
FALMOUTH	TAUNTON	HANSON
HARWICH	RAYNHAM	HINGHAM
MASHPEE	ROCHESTER	KINGSTON
ORLEANS		MARION
SANDWICH		MARSHFIELD
TRURO		MATTAPOISETT
WELLFLEET		MIDDLEBOROUGH
YARMOUTH		PEMBROKE
		PLYMOUTH
		PLYMPTON
		WAREHAM

### METHODOLOGY

Abandoned cranberry bogs were identified by the WCP from 1:12,000 color infrared (CIR) photography flown in April, 1993. A rough delineation of the boundary of each abandoned bog and an estimated center point was marked on a stable mylar overlay. The estimated center points of the abandoned cranberry bogs were then visually compiled onto paper (1:25,000 scale) GIS base maps and digitized. The area of each abandoned bog was estimated from the rough delineation on the mylar overlay, and the center points were buffered by the estimated area.

Abandoned bogs were identified through evidence of landscape features indicating previous cranberry growing activity, including surface hydrologic features and evidence of ditching or diking. Conducted by experienced wetlands delineators, this method provided accurate assessment of sites greater than 1/2 acre in size that had a high probability of being abandoned cranberry bogs. Comprehensive analysis and processing of the CIRs, combined with field survey work could be expected to identify more possible abandoned cranberry bogs.

### ATTRIBUTES

The abandoned cranberry bog datalayer has a polygon attribute table (.PAT) containing the following items:

CBBOG-ID	Unique identifier consisting of flight line number, photo number and ab_unit number
F-LINE	CIR flight line number
PHOTO#	CIR photo number
AB_UNIT#	Unique integer code for each abandoned bog on a CIR
CLASS	Wetlands classification (available for Cape Cod only)
ACRES	Estimated area of abandoned cranberry bog in acres
SQ_FEET	Estimated area of abandoned cranberry bog in square feet (sq. ft.)
RADIUS2	Estimated area of abandoned cranberry bog in sq. ft. divided by pi (used to determine bog buffer radii)
CB-BUF	Bog center point buffer radius in feet
CB-BUF-METERS	Bog center point buffer radius in meters

### MAINTENANCE

The DEP GIS Program maintains this datalayer.

## DEP Eelgrass Datalayer

July 1999

### OVERVIEW

Seagrass beds are critical wetlands components of shallow coastal ecosystems throughout the state. Seagrass beds provide food and cover for a great variety of commercially and recreationally important fauna and their prey. The leaf canopy of the seagrass bed calms the water, filters suspended matter and together with extensive roots and rhizomes, stabilizes sediment.

Eelgrass, *Zostera marina*, is the dominant seagrass present on the Massachusetts coastline. Another species, widgeon grass, *Ruppia maritima*, is present in areas of less salinity along the Cape Cod and Buzzards Bay coast. These seagrasses (and others not present in Mass.) are collectively categorized as submersed rooted vascular beds (SRV).

SRV are phototrophic plants requiring sunlight to conduct photosynthesis. The depth limit for SRV is a function of the penetration of light sufficient for net photosynthesis by these autotrophic rooted plants. In the more turbid waters of portions of Buzzards Bay and Cape Cod, this depth limit is less than 3 meters mean lower low water (MLLW). In the clearer waters of Nantucket Sound and the North Shore the depth limit is greater than 6 meters MLLW.

An accurate mapping inventory of the state's coastal SRV resources had not been previously conducted. The Mass. Department of Environmental Protection (DEP) Wetlands Conservancy Program (WCP) has developed and completed a project to map the SRV resources of the entire Massachusetts' coastline. This mapping effort was conducted with the financial and technical assistance of the National Oceanic and Atmospheric Agency (NOAA) Coastal Change Analysis Program (C-CAP) and the NOAA Coastal Services Center located in Charleston, SC. The project (conducted from 1994 through 1997) acquired aerial photography and conducted photointerpretation and extensive fieldwork to map the coastal SRV resource.

MassGIS distributes these data as two statewide layers: the **EELGRASS** polygon coverage, and the **EGRASVPT** point coverage.

### METHODOLOGY

The mapping process involved the following steps:

*Acquisition of Aerial Photography*  
*Photointerpretation of SRV resources*  
*Fieldwork to confirm Photo-interpreted features*  
*Compilation to Digital Base Map*  
*Independent Accuracy Assessment Procedure*

#### *1. Acquisition of Aerial Photography*

Aerial photography (Aerocolor 2448 color positive film) at a scale of 1:20,000 was acquired over the period of 1993-1996.

Nantucket

Martha's Vineyard, Southern Cape Cod and Elizabeth Islands

Northern Cape Cod, South Shore, Boston Harbor and North Shore

Buzzards Bay and Mount Hope Bay

Photography was captured utilizing the following specifications:

80% endlap

30% sidelap

Low tide

Sun Angle of < 25 degrees from horizon

Wind < 10 mph

Minimal haze

Minimal turbidity

## *2. Photointerpretation*

The accurate identification of SRV in aerial photographs requires visual evaluation of the fundamental elements of image interpretation (tone, color, contrast, texture and shadow). It also requires extensive experience at ground level in the particular study area. The photographic images of SRV and other benthic images vary in ways that cannot readily be modeled, described or communicated. Training for SRV photointerpretation includes: literature research, discussions with local ecologists and biologists, site visits, overflights in a small plane, and examinations of historical aerial photographs of the area.

SRV are observed best using stereo pairs of photographs and high quality stereoscopic instruments (DEP WCP uses a Cartographic Engineering Ltd. Model SB 190). SRV polygons are traced on overlays fixed to each photograph. Minimum mapping unit is 20 meters. SRV (and other benthic features) in a given area will present a variety of signatures depending upon the bottom sediment, depth, season and haze. Shadows from clouds or trees, turbid water, white caps, or sun glint may obscure SRV signatures in the photograph.

## *Fieldwork*

Extensive fieldwork was required to verify that the photosignature was SRV or some other type of benthic feature (macroalgae, mussel bed, dark sand, shells, rock, or other). SRV can also be combined with any of these other benthic features. Fieldwork was conducted in a small boat using surface observation and underwater observation for which an underwater video camera system was utilized. Field notes were compiled on the overlay of the aerial photo to be used in the final photointerpretation process.

## *Compilation to Digital Base Map*

The interpreted overlays were scanned using a photogrammetric quality scanner (AGFA Horizon Plus) at a resolution of 600dpi resulting in a pixel resolution of .85 meters. The resulting image file was rectified (bi-linear 2<sup>nd</sup> order) to 1 meter color digital orthophotos supplied by Mass. Office of Coastal Zone Management. The polygon delineation from the rectified image was then digitized onscreen and coded for habitat type. In addition to the photo interpreted eelgrass polygon coverage (EELGRASS), a point coverage (EGRASVPT) was generated based on field-verified sites as well as all field-verified observations of widgeon grass (*Ruppia maritima*) and algae. The rectification and digitization was completed by the NOAA Coastal Services Center using the ERDAS Image software package.

## *Accuracy Assessment*

The resulting polygon vector coverage was accuracy-assessed by NOAA C-CAP in July 1997 and September 1998. The assessment was based on random points generated with the polygon boundaries. Navigation to each point in the field was accomplished using real time differential GPS (DGPS). The accuracy assessment of the digital SRV data revealed that 85.4% of the beds had been correctly mapped.

## ATTRIBUTES

The attribute tables (.pat) for both the eelgrass polygon vector data and the field verified point data contain a single item called HABITAT, and the following codes:

Coverage	Field	Codes
EELGRASS	HABITAT	eelgrass, no eelgrass, rupia
EGRASVPT	HABITAT	algae, codium, eelgrass, no eelgrass, rupia

## Code Definitions:

<u>Code</u>	<u>Definition</u>
Algae	Various forms of coastal macroalgae
Codium	Green algae with conspicuous large shape
eelgrass	Coastal submerged rooted vasucular plant – a seagrass
no eelgrass	Areas with NO <u>observed</u> eelgrass or algae
rupia	A vegetation found in shallow areas with varying salinities

## LIMITATIONS

Extent of Inland Mapping Coverage

The project area for this data is the Massachusetts coastline. For coastal rivers which empty into the ocean, the up river extent of the polygon boundary was most often terminated at the first major highway bridge crossing.

Photointerpretation

Due to the limitations of the aerial photo interpretation process the extent of the SRV data presented with this mapping product should be considered conservative. The following factors contribute to this underestimation of SRV:

- the aerial photograph might have been captured when atmospheric and hydrospheric conditions were less than ideal ,
- the experience of the photointerpreter,
- nature of the subject area (dark underwater substrate), and
- the quality and amount of surface level field data.

## MAINTENANCE

The Massachusetts DEP Wetlands Conservancy Program (WCP) maintains the eelgrass data. Updates are planned to be conducted on a 5-year cycle:

1999	Nantucket and Martha's Vineyard
2000	Cape Cod
2001	South Shore, Boston Harbor and North Shore
2000	Buzzards Bay, Elizabeth Is., Mt. Hope Bay

Please contact Charles T. Costello – (Section Chief) DEP WCP, (617) 292-5907, with any questions.